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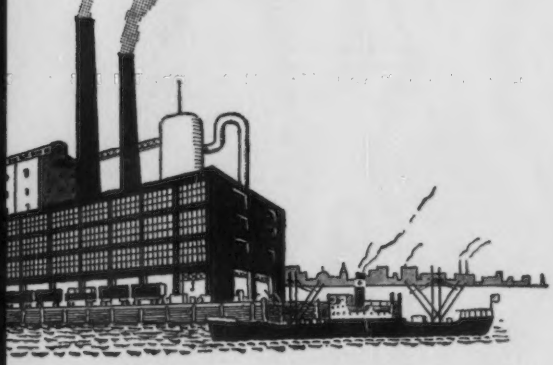

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All articles should be typed on 8½ x 11 inch paper and should be double-spaced. Authors are requested to send with each article a statement as to the field work, special experience, or other background on which the article is based. They are also urged whenever possible to submit maps and graphs in such form that they can be reproduced directly. In cases where it is necessary these will be redrawn at the editorial offices, but this may result in delay in publication. Delay will be avoided, also, if the author will send a caption with each illustration. All map or chart captions should show the source of data or other information unless this is already given in the illustrations. The sources of information for all tables, too, should be shown. Wherever a photograph is used that was not taken by the author, some source credit should appear in the caption.

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OF INTEREST TO CONTRIBUTORS

You probably have never read the material in fine print on the inside of our front cover. That's why I want to take this occasion to call your attention to some suggestions that appear there under the heading INFORMATION FOR CONTRIBUTORS.

We can begin with one simple request, that the author send with his article a statement as to the field work, special experience, or other background on which his article is based. Of course you and your work may be so well known to the editor that such a statement is obviously unnecessary, but more often than not a few words of introduction will help.

The text of each article should be broken by headings of some sort. This is something that can best be done by the author himself. Though unity of material is a primary factor in dictating the placing of such headings, ideally each page or at least every other page of the final magazine article should have a heading somewhere on it. It is better to stick to one level of headings if possible. These are centered on the page. But sometimes a second level, italicized subheads at the left of the page, become necessary. Third level headings, sometimes called subsidiary headings, are to be avoided. A heading should never follow immediately after the title of an article and a heading should never be immediately followed by a subhead; instead, some text should intervene. One last word about headings and subheadings: never assume them in the text. An article should be so written that it would be complete if all the headings and subheadings were deleted.

Maps should, if possible, be one-third to one-half larger than final magazine size. We like to have the original maps submitted, but if you have a huge map, say four or five feet on a side, we suggest that you have it reduced to one-third or one-half the size you expect it to be in the magazine. This will tell you as well as the editor whether or not your map will reproduce satisfactorily without redrawing, and it will save his having to handle awkward-sized maps. It is unnecessary to have captions printed on the maps since such material can be set in type beneath the maps.

A reasonable number of photographs can be used but only where they are of definite value in the article. Credit should always be given unless the photo has been taken by the author himself. And please do not send negatives. Send glossy prints instead.

Reference footnotes are welcome since the citation of sources is a part of scholarly research, but don't overdo it. Informational footnotes, especially if they are long, should be avoided, since such material can generally be worked into the text of the article. We ask that all footnotes be typed between parallel lines right in the text wherever they occur instead of being placed at the bottoms of pages or at the end of the article. It is surprising how few pay attention to this request even though they are writing specifically for ECONOMIC GEOGRAPHY.

Still other details will be found in that fine-print section referred to at the beginning of this article. For example, you will find information on the fields covered by the magazine, the way in which your paper should be typed and presented, and about galley proof and reprints.

When would-be authors follow the instructions we have been talking about they make the editor's task easier and they sometimes influence his decision thereby. But never lose sight of the fact that conformance with all the rules and regulations in the world won't necessarily produce an acceptable article. It is vastly more important to have something worth while to say and to say it well.

R. E. M.

ECONOMIC GEOGRAPHY

VOL. 34 JULY, 1958 NO. 3

THE CHANGING RELATION OF NATURAL RESOURCES TO NATIONAL SECURITY

*Harold J. Barnett**

Dr. Barnett, an economist, is Director of the Resources and National Growth Division, Resources for the Future, Inc. His division is primarily engaged in research on the long-term interaction of economic growth and natural resources availability.

MY assignment here is to convey information—facts and ideas—on the relation of natural resources to national security. This subject matter cannot be neutralized from government policies and behavior, or from social values. At its core, it concerns social goals, international relations, politics, economics, and other fields of social analysis. It is an arena where non-physical variables such as military alliances and other international relations are the major influences, and where value judgments concerning the world and national societies in which we want to live, on such matters as democracy, free enterprise, and durable peace, set our objectives.

With this warning, let us now define our terms rather quickly. By national security we mean long-term security from hostile military behavior. This excludes from our consideration a non-military concept of "security"—the conservationists' and ecologists' concepts of a durable and secure balance between man and nature. By natural resources, we mean both the flow of useful materials from our physical surroundings, and the spatial relationship which this environment provides. By the relationship between our two variables, we mean both the direct and indirect influence of natural resources upon national security.

A few sentences will suffice to tell my outline. I first discuss *lebensraum*, a philosophy of world growth in which resources are held to be a major cause of war. This is the most general and widely held public view concerning the relation of resources to war. In the next part I survey and comment on three more specific, narrower, but also accepted views on resources and war. The heading "Materials for War" validly describes that these views are concerned with resources as an instrument for the prosecution of war. The views are not inconsistent with the *lebensraum* doctrine, and, in fact, in some respects derive from its more general principles.

*I am indebted for advice and criticism to several of my colleagues—R. G. Gustavson, J. L. Fisher, N. Potter, F. T. Christy, and H. Jarrett. The opinions expressed are, however, personal ones and not organizational policies or attitudes.

In the final part, I turn to United States policies concerning the resources-security relationship, present some assumptions and evidence, and derive therefrom some tentative conclusions.

LEBENSRAUM

One major aspect of the *lebensraum* doctrine emphasizes the importance of space, position, topography, weather, and the like (which for convenience I call spatial relationships), as determinants of military security. This relationship operates at several levels. It is subsumed in international policies where it operates (other things equal) to minimize frictions and prevent war, as for example, by putting great distance between Western hemisphere nations and Asiatic ones; or to facilitate war, as for example, between Egypt and Israel, or France and Germany. At another level, the space relationship influences military strategy. For example the Channel protects Britain from invasion; the oceans invite submarine warfare against the United States and inhibit ground attack; and the fact of relationship of space and security prompted Russian utilization of vast and frigid space to defeat the Napoleonic and Hitler invasions, and neutralized the historic conquests of China. Finally, space is a dominant influence upon military tactics, as we remember from our World War training and action, or from reading Major Eliot.

It is inevitable that the space factor will always have some importance for differential national security. Yet it is becoming less of a differentiating factor with the advance of technology which shrinks the world, and in this sense becoming less important. We no longer depend upon space to prevent conflict between the United States and Russia, nor to reduce significantly the mutual hurt which conflict would bring. And this is because the space between formerly distant countries has shrunk to a matter of hours, no less than because of weapon technology advance.

In addition to the fact that space is becoming less capable of *differentially* influencing national security of the several nations, the shrinkage of space is also weakening absolutely the security of all nations and of mankind in a revolutionary way. One of the functions of space is that it provides capacity to absorb pressures and tensions among nations. While some of the forces of growth in recent world history have been of the type which reduce international pressures and tensions, most of the forces have operated to increase these. The pressure-increasing forces include, among others, sheer numbers and weights of aspiring national groups; increased dependence upon international trade and other intercourse; and the thrust of civil and military technology. And this trend of increased pressures and tensions has coincided with a loss of space in two meanings—its reduction in terms of time intervals between nations; and the merging into a single world unit of what were formerly distinct and separate national atmospheres, and formerly unused "satellite space."[1]

It is tempting to give physical analogies of the importance of space as a cushion and shielding device, and of the dangers from its shrinkage. The most apt analogy, I think, is the simple electrical one of short-circuit. Space may be used to insulate a wire carrying an electrical load. Let the charge build

[1] I use the atmosphere and satellite examples because of the widely publicized radioactive fallout threat and the first satellite excursion this year. According to the late John von Neuman, the threats and promises of world climate control and ice-cap melting are no less significant. See his "Can We Survive Technology?" in *The Fabulous Future* (New York: E. P. Dutton & Co., 1955–56), pp. 39–42.

up or the space decrease, and the threat of short circuit increases. At sufficiently high charge or small enough space, the malfunction is continuous and the design, which depended upon space for insulation, obsolete. "The great globe itself is in a rapidly maturing crisis—a crisis attributable to the fact that the environment in which technological progress must occur has become undersized . . . literally and figuratively, we are running out of room. . . . Thus the crisis does not arise from accidental events or human errors. It is inherent in technology's relation to geography on the one hand, to political organization on the other."[2]

Raw Materials Pressures

The second aspect of the *lebensraum* doctrine might be called "raw materials pressures." The view is that growth of populations and levels of living press upon limited natural resources and thus generate international tensions and war. Much public belief and scholarly research subscribes to this opinion of the relation of natural resources to war. In support of the view its proponents parade the list of modern wars. They point to colonialism of the eighteenth and nineteenth centuries and the several major and numerous minor wars which created the colonial empires of the European nations. In the twentieth century, they point to the expansionary efforts of Japan, which produced the Russo-Japanese War, the Japanese invasion of China in the 30's, and the Japanese declaration of war in 1941; the empire quests of the German Kaiser and of Hitler and the consequent two World Wars; the Italian invasion of Ethiopia; and perhaps the current scramble for Middle East oil.

[2] *Ibid.*, pp. 33–35.

But the case for this relationship of natural resources to war is not as conclusive as this. A first possible criticism has to do with the evidence. The list of wars allegedly due to drive for raw materials claims too much. In most of the cases just given, it is the nations with high and improving levels of output per capita which incite the war—the Western European nations in the colonial period, and Germany, Japan, and Italy in this century. It is nations able to procure raw materials from indigenous sources, from technological substitutions, from international trade. Yet the hypothesis is that they were driven to war to get raw materials. Is there not inconsistency here? On the other hand, one can think of cases of major nations with a high ratio of population to developed resources who have not started wars to get materials, for example, India and China. Finally, even if belief in need for raw materials by conquest is one influence leading to war, was it the dominant or even a main one? What of the hypotheses that wars are generated by need for markets to dispose of industrial goods, as has been charged against Germany; or by national ambitions, as charged against Italy and Japan; or by envy deriving from relative economic welfare or relative political power as compared with, say, the United States; or by the personal drives for power of dictators, such as Hitler, Mussolini, and Stalin? Does it not appear, perhaps, that not only is it difficult to establish shortage as a sufficient or necessary condition for war, but that it is even difficult to be sure that it is a very major influence in generating war?

The second criticism that might be made is of the validity of the Malthusian-type doctrine upon which this raw materials shortage view rests. Is it clear that high ratios of population

to developed resources inevitably bring lower standards of living and thereby incite nations to war? What of the role of technological advance and capital formation in permitting improved welfare simultaneous with population increase? What of the role of international trade as an efficient provider of materials for developed nations, and capital and know-how for less developed ones? And is there not some evidence of retardation of birth-rates over the long term as incomes rise and knowledge of birth control increases?

I find this question quite complex, and understand it only partially and imperfectly. I would argue against elevating the raw materials element of the *lebensraum* doctrine to something equivalent to natural law. But I would not deny that public belief in it has been significant in generating international tensions. For it is not enough to observe that per capita incomes have been increasing the world over if aspirations in low income nations generate emotional heat, as is presently the case in the Middle East. And it is not enough to say that international trade, foreign investment, and technical assistance are possible, if international tensions and uncertainties are such that the world has not come to believe these to be dependable as foundations for national welfare. If the United States at times betrays anxieties over dependence upon Malaya and Indonesia for tin and rubber, how much more anxious might France be over reliance on Middle East oil, or Brazil and Cuba over dependence upon foreign purchases of their coffee and sugar, respectively.

International trade seems capable of a Dr. Jekyll and Mr. Hyde role. That in general it is to mutual advantage is demonstrated in the chapter on the principle of comparative advantage in any elementary international trade text. After all, economic development of raw material producing nations is limited by their ability to market products on a sustained basis. And developed nations have equivalent reciprocal need to market fabricated products. In theory, the principle is similar to that of regional and urban-rural interdependence in the United States. The difficulty is that the mutual dependencies built up may not be symmetrical, and in the international arena of independent, sovereign nations, this may properly generate anxieties primarily on one side. Although the ratio of imports to gross national product in the United States is only about 4 per cent, the similar ratio is 10 per cent in Japan; 20 per cent in Britain; 30 per cent in Belgium, Cuba and Iceland; and 50 per cent in Venezuela. Thus a nation like the United States that is not very dependent on foreign trade may have much leverage over nations like Cuba or Japan which are heavily dependent on it and do not have good alternative markets for buying or selling.

The case of Japan is illustrative. Japanese population grew about 15 per cent from 1912 to 1925. National income and industrial output increased several times as much, and Japan became dependent on imports for two-thirds of her petroleum, and over 90 per cent of her iron ore, phosphates, and raw cotton. Simultaneously, she developed a large silk trade, which in the 1920's constituted one-third of her total exports. Between 1926 and 1934 the price of silk exports dropped 65 per cent, as a result of world-wide depression and the introduction of rayon. This drop in price reduced the revenue by an equal percentage, since export quantities changed comparatively little. And thus her purchasing power for imports of grains, cotton,

petroleum, etc., was cut by about 15 per cent, in the face of needs that were rapidly increasing as a result of industrialization and rising population.

In our discussion of space as a military parameter, above, I suggested that possibly it was becoming less influential as a differentiating factor. What about the future role of population growth and quest for raw materials as an influence on war? In one sense, this also may be becoming less important. Technological advance in materials substitution, for example atomic energy, plastics, and light metals, has been extremely rapid. Atomic energy, particularly, promises to reduce tensions from growing energy needs. Rises in income per capita are more world wide than ever. Capital formation is at high rates. Birth rates in advanced countries are less than a century ago. The world's two major contesting powers, the United States and the Soviet Union, are both well endowed with natural resources. On the other hand, as I have just pointed out, the problem may go beyond "need" in a physical sense, to that of "desire." And the number of nationally-conscious, nationally-aspiring countries is now larger than before the two World Wars, as the present Middle East crises show.

MATERIALS FOR WAR

It is generally believed that war and preparations for war call for enormous increases in raw materials consumption over peacetime levels. (This, in turn, leads to the worry that such level of consumption might quickly exhaust the nation's natural resource wealth.) I am not sure how the view of enormous increases has become popular; but that it is in part erroneous is suggested by the fact that present and recent annual levels of fuel and minerals consumption exceed those of World War II (see Table I, last five columns).

TABLE I

U. S. CONSUMPTION OF SELECTED RAW MATERIALS

1935–39 = 100

Commodity	*Average 1935–39*	*1943*	*1946*	*1949*	*1954*	*1955*
Lumber	100	159	143	153	169	184
Cotton	100	160	146	117	125	133
Pig Iron	100	200	149	177	194	256
Copper	100	258	239	183	212	229
Zinc	100	151	148	131	163	199
Aluminum	100	664	436	482	1,286	1,323
Fertilizer	100	156	203	224	282	278
Cement	100	120	159	194	258	280
Petroleum	100	127	154	173	226	242
Natural Gas	100	162	183	258	460	502
Bituminous Coal	100	156	131	117	95	111

Source: Data are preliminary, from Resources for the Future worksheets of research now underway by F. T. Christy. Based upon published data of U. S. Departments of Commerce, Agriculture and Interior; *American Metal Market*; and American Bureau of Metal Statistics.

The view may derive from public knowledge of very large increases in World War II consumption of raw materials over the levels of the immediately preceding peacetime years—compare the first two columns of Table I. But the 30's were years of substantial unemployment, of relative depression, particularly in such activities as construction and equipment production. One out of each six people in the civilian labor force during 1935–1939 was unemployed. And thus outputs of many raw materials in the 30's, particularly minerals, were relatively low, due to low economic activity as compared with the all-out employment levels we achieved in World War II, or the full employment levels since its close. In general, the excess of wartime output over peacetime full employment might be of the order of twenty per cent for a war of World War II type. (The case of thermonuclear war is discussed in a later section.)

Perhaps the view of enormously enlarged materials requirements em-

bodies the premise that war and war preparation are peculiarly *intensive* in their requirements for raw materials. And, thus, even if the overall level of national product rose only moderately, nevertheless the demand for raw materials could rise immoderately. This is undoubtedly true for some materials —e.g., uranium, titanium, steel armor plate and others. But, in general and in the aggregate, we find that demands for industrial raw materials per unit of national product for a wartime "product mix" are not markedly different from those of peacetime. This is illustrated in Table II. The reason is that many of the luxuries we give up in preparations for war or in wartime because labor is the major scarcity—new automobiles, unlimited travel, new housing construction, new household appliances, etc.—are just as materials-intensive as the war goods which we produce instead.

Military Strength as a Function of Natural Resource Wealth

Our discussion of raw material requirements for war just now has in part implicitly discussed the concept of military strength being a function of natural resource wealth. But a few words directly focussed on it are desirable. The view is that military potential depends on natural resource wealth, because economic war potential depends on natural resource condition—e.g., that the military strengths of the United States and the Soviet Union are determined by their natural resource riches.

The dependence of military strength upon natural resource riches has, perhaps, been overstated. It is true that the United States and the Soviet Union, the most powerful military nations in the world, are richly endowed with natural resources. But observe that there are other nations as rich or richer in this endowment who are not militarily strong—Brazil, India, Canada, large areas of Africa. Apparently, then, natural resource riches are not a sufficient condition for military strength. Now observe that until the rise of the United States and the Soviet Union to dominant positions after the last war, Germany, England and France were also first-class military powers, on a par with the United States and Soviet Union. Apparently, then, further, since these West European countries are less well-endowed than many militarily weak ones, natural resource riches were not a necessary condition of military strength.

There is of course no paradox here, but oversimplification. Military strength does depend on natural resources. But provided the resources are available, they need not be indigenous. Further, military strength requires an advanced industrial society, with all that this implies for technology, education, labor skills, capital investment and so forth. And contemporaneously it places a premium on military forces in being upon outbreak of war. Finally, military strength up to recently, at least, has required relatively large population size.

TABLE II

U. S. CONSUMPTION OF SELECTED RAW MATERIALS PER UNIT OF REAL GROSS NATIONAL PRODUCT

1935–39 = 100

Commodity	*Average 1935–39*	*1943*	*1946*	*1949*	*1954*	*1955*
Lumber	100	94	89	93	82	84
Cotton	100	94	92	71	61	60
Pig Iron	100	117	93	107	95	116
Copper	100	152	150	112	104	104
Zinc	100	88	92	79	79	90
Aluminum	100	393	275	294	630	606
Fertilizer	100	91	126	135	137	126
Cement	100	71	100	118	126	127
Petroleum	100	75	96	104	110	110
Natural Gas	100	95	114	156	223	228
Bituminous Coal	100	91	82	71	46	50

Source: Materials consumption from Table I. GNP from U. S. Department of Commerce.

The proposition that luxurious United States standards of living and resource use are exhausting its natural wealth and thereby propelling it toward the status of a second-rate military power within the next century or so is even more serious oversimplification. It stems from viewing resource wealth as a bank account or reservoir from which only withdrawals take place, to reduce the balance. But withdrawal is not the only thing that occurs with the passage of time. New resources are constantly being discovered, made usable, and added to our wealth—uranium, oil shale, magnesium from the sea, aluminum from clay, oil from the ocean bed, steel from taconite and so forth. Other technological changes reduce the amount of resource we need to get a unit of product, as for example, in the increased efficiency in combustion of fuels in electric power production and railroad transport; or the amount of steel needed to carry a transmission line. And still other economic change occurs. This whole question is, I suggest, far more complex than the simple notion of a fixed stock being drawn upon.

U. S. Production Self-Sufficiency

Finally, there is a widely held belief that if war occurs we may find ourselves cut off from foreign sources of essential raw material supply outside the nation. It has been vigorously argued that the nation must undertake to assure national production self-sufficiency for all those requirements of war for which this is physically possible, irrespective of the cost or of the international repercussions. Further, it is the full level of wartime materials requirements for which domestic capacity must be in being. Since in some cases the costs would be very high, strenuous government interventions are necessary and desirable—protective tariffs high enough to exclude foreign supplies; government price and other guarantees; government loans; and other subsidies.

The production self-sufficiency thesis is, in my view, basically erroneous. It damages the free world military alliances; it is excessively costly; it tends to damage our free-enterprise economy; and it seeks to buy excessive insurance against yesterday's type of war at the expense of insurance against today's hazards. These points are elaborated somewhat in the next part of my paper.

SUGGESTIONS CONCERNING NATIONAL RESOURCES POLICY FOR NATIONAL SECURITY

My first suggestion is that it is impossible to avoid casting the topic as one of high governmental policy and behavior concerning natural resources and national security, with all that this implies concerning assumptions and goals. After all, private persons do not make decisions in this sphere. Further, once the problem is thus posed, a most useful implication appears: The solution needs to be consistent with United States economic policy and international policy. These constitute a larger body of national objectives and behavior in which natural resources and national security are but components. It becomes clear that the wisdom of governmental natural resources policy proposed as improvement of our defense must be economically sensible, in terms of the benefit exceeding the cost, and the efficiency of the preferred policy as compared with others. It becomes clear, also, that current decisions must be made without certainty of whether there will be war, of when there might be war, or of what kind of war the next one might be. It becomes relevant to observe that there is plentiful availability of weapons in the multimegaton sizes, and no presently foreseeable progress in defensive weapons sufficient to prevent

delivery of hundreds of these to target areas in the several nations. And finally, it seems clear that we can no longer hope for anything approaching absolute national security—that the increased defense we can procure in this age will fall extremely far short of being security in the sense of certainty.

The national income of even the United States is not large enough to support advance preparations for all conceivable contingencies in this shrunken world. And still less abundantly adequate is the portion of national income which our democratically-controlled country is willing to devote to such purposes before war.[3] We have just seen military budgets cut to avoid raising the national debt limit. Just as the task for military policy is to arrive at some combination of forces that is sensibly related to the probabilities, so natural resource and other economic policy must also be based on consideration of specific probabilities, individually and in combination. Ultimately, both military and economic policies must be closely related to the war plans they are designed to support. How can it be possible for sensible economic measures aimed at improving our military security not to be related to actual war plans and foreign policies?

Premises Concerning Types of War and Probabilities

If rational decisions are to be made, we must visualize four kinds of possible war and the likelihood of each. The four are: (1) prevention of war, and thus no war; (2) peripheral wars; (3) major world war without thermonuclear bombardment of cities; (4) unlimited thermonuclear war. I shall discuss each, in turn, after which I shall point up the implication for natural resources.

[3] As of date of writing in mid-1957.

(1) *Prevention of war. No war.*—The United States and Russia (and soon other nations) have the capability of literally destroying each other's—or anybody's—urban and industrial societies. Hence I think that all nations will strenuously try to avoid major wars; and there is a possibility that they will be successful. With respect to this possibility, I quote the President (as reported in the *New York Times*, February 7, 1957):

> "The vulnerability of any nation is probably greater than it ever was, because one bomb today can do the damage of probably all that we dropped on Germany in World War II. . . . Of course anything is possible in this world in which we live. . . . But I say this: The likelihood of any nation possessing these great weapons of massive destruction using them in an attack grows less, I think, every year. I believe as their understanding of them grows, then the less the chance that they would go on an adventure that brought these things into play, because, as I see it, any such operation today is just another way of committing suicide."

As a way of avoiding war, the United States seeks to create a strong free world alliance to stop Soviet political and economic expansion into Western Europe, the Middle East and Asia. An appropriate question, then, with respect to any contemplated economic measure concerns its contribution to this United States strategy of preventing war: would the measure weaken or improve free world unity? If it would damage relations with other free nations, what is supposed to be the offsetting advantage? This question is not trivial—it is possible to believe that our free world alliances and relations with neutrals are of the same order of importance in containing Russia and preventing war as the United States military strength *per se*. And, to a major degree, therefore, government policies must be designed to strengthen

these alliances and our comity with neutrals.

(2) *Peripheral wars.*—Consider now the second possibility: that Soviet expansionary adventurism will engage us in Korea-type wars at one or more points. This also is not a far-fetched assumption. For proof, examine the composition of the nation's military forces and the public statements of their leaders. Or think over the history of the past dozen years and the crises in Greece, Turkey, Iran, Yugoslavia, Indonesia, Korea, Indo-China, Formosa, Malaya, the Middle East, and Hungary. Or recall that we have as national policy the determination to risk or engage in localized wars, if necessary to deter Soviet expansion and major war.

What economic measures should we take to prepare for this contingency? Our need in this case—in which the battleground could be as varied as the Middle East, Indo-China, the Balkans or a Polar area—is first, to have flexible military forces and munitions properly positioned to contain such thrusts. Second, we need reservists and military supplies in readiness and strategically located, in the United States and elsewhere, to be able to supplement such forces in days and weeks. Third, we need help from other countries—both those attacked and other allies. We need their economic and military strength as well as the benefit of common aims.

(3) *World War II-Type hostilities.*—The third possibility is a large-scale, long World War II kind of action in (say) Europe, in which both sides abstain from thermonuclear bombardment of home territories. It is really quite difficult to believe that this could happen, and from a reading of public statements it does not appear that the military are preparing to fight World War II all over again. One reason is that tactical use of nuclear weapons in populated areas would quickly develop into nuclear strikes against home territories. A second is that our whole deterrence program rests upon Soviet and our belief that the Soviet Union will experience swift retaliation by the Strategic Air Command if, for example, she invades Western Europe. A third is that in any lengthy large-scale war in which both sides have thermonuclear capabilities but have refrained from using them, only a stalemate outcome could induce continued abstention of their use. If Hitler had thermonuclear warheads, would he have refrained from their use in the V-1's and V-2's which showered England and Belgium in 1944 and 1945? And, finally, even if both sides try to confine use of thermonuclear weapons to military targets, such as the opposing strategic air-bases, ports, rail centers, etc., the numbers of weapons involved and their lethal areas of radio-activity would make the effects on civil population hardly distinguishable from attacks on cities proper. Please note that I am not saying that any war between the United States and the Soviet Union must be a thermonuclear one. We just discussed such a situation under the heading "peripheral wars." I am saying that any war begun as, or developing into, a massive, long one of the World War II type would with high probability become a thermonuclear war, and thereby a short one.

If it is a new type war, with modern weapons, that we visualize, then massive conversion of the economy following outbreak of war and estimates of materials required in such

mobilization along World War II lines have dubious relevance.

But there is a strong human tendency to look ahead in terms of the recent past. Despite the intellectual awareness that the next large war—if there should be one—will be different, much of the economic planning and discussion of economic policy seems to be in terms of a conflict much like World War II. To the extent that preparation for such a war is desired, it must rest upon detailed plans for converting the economy to war output following outbreak of war. In such plans, it will become possible to identify specific bottlenecks and shortages which, if not prepared for, would delay the mobilization schedule. It is only on the basis of identification of specific bottlenecks that economic preparations can be justified; for otherwise the measure, such as particular industry assistance or a stockpile, might merely generate some fat in the economy not closely related to anything. Further, mere identification of bottleneck does not by itself specify the most sensible measure from the large variety of alternatives. There still remains the task of intelligent choice.

(4) *Major thermonuclear war.*—Finally, despite efforts to avoid war, to restrict war to small scale, and at least to restrict war to the nonsuicidal form, there is the fourth possibility—that a war involving thermonuclear bombing of cities and correlative radioactive "fallout" on most of the country will take place. Sensible prewar economic preparations for this contingency are not likely to be similar to those required to avoid bottlenecks in the World War II type conversions just discussed. There will be little time or occasion for World War II type military output if an atomic war devastates the whole economy at its outbreak. Such a war involves the prospect of millions, perhaps tens of millions, of mortalities, and equivalent numbers of wounded and sick. At the same time there will be wholesale destruction of essential water, food, medical, communication, transport, housing and other services. I am sure that the military services have adequate plans for continued supply, from remaining munitions stocks, of such military forces as survive. But what the United States needs in addition are passive defense measures.

These are desirable for two reasons. First, the effectiveness of our deterrence policy requires belief by our leaders and by the enemy that the deterrence force can be used against him if he incites a major war. Second, such measures are needed, should deterrence fail, to reduce casualties and to reconstitute a viable society out of the remnants of population and economic resources that survive. As to the instruments of passive defense, the list is a long one—country-wide shelters against radioactivity and urban ones against blast; warning time; dispersal and evacuation; stocks of subsistence goods; survival and recuperation plans. While the possible combinations are quite complex, shelter protection of the entire population against radioactive fallout and of urban populations against blast, in addition, are central to any solution.

From our examination of four types of war, we can highlight several points:

(a) Because of the advance in military technology, the dangers to national security and the costs to offset them are so high that we must be selective in our defense efforts.

(b) The possibility of preventing large-scale thermonuclear war (by a strong deterrent force, by free world alliances and by risking small peripheral war) is so desirable, the probability of success is so high, and the cost is so clearly manageable, that this is obviously our major objective. This requires among other things, fidelity to principles of international cooperation; and emphasis on substantial flexible military forces in being and readiness.

(c) The small likelihood that a large-scale, long war could occur without thermonuclear bombing of the United States, the disorganization and destruction of United States industry which would take place if subjected to thermonuclear bombing, the fact of economic superiority of the United States over the Soviet Union if both sides refrain from thermonuclear bombing—all these argue against diversion of large efforts from direct military preparedness for the purpose of achieving self-sufficiency in production capacities, particularly if at the expense of international trade with the free world.

(d) Finally, it is desirable to give more serious and effective attention than heretofore to protection of the civilian population against thermonuclear attack. Because offensive capability (against home economies) has completely outpaced the development of defensive measures since World War II, there should be no illusions that such protection is cheap or that it can be secured beyond a moderate degree at all. The February 14, 1957 *New York Times*, for example, reports that the White House is considering a plan for atomic shelters, estimated to cost $20 to $40 billions.

The following quotations are interesting and relevant as summary statements of the military probabilities:

> "Should a nuclear war come, I think its duration is likely to be inversely proportional to its size. I do have the feeling that a big nuclear war will never come. But if it comes, the period in which such a war will be most devastating will be very short, indeed. It will be measured in hours, possibly in fractions of hours. The period in which the decision is made as to who wins the war, on the other hand, will be long, such as ten years preceding the time of the war. The actual fighting will be, I think, a matter of days or weeks." (Physicist Edward Teller in the Washington *Sunday Star*, January 13, 1957, p. A-28.)

> "Destructive power has now become so cheap that wars can be won or economies destroyed before there is time for mobilization. In allout thermonuclear war the superior economic war potential of the United States is important only to the extent that it has been effectively diverted to security purposes before the war starts." (Economist Charles Hitch in *Defense Essentiality and Foreign Economic Policy* in Case Study: The Watch Industry and Precision Skills; Hearing before the Subcommittee on Foreign Economic Policy of the Joint Economic Committee, 84th Congress, 2nd Session; Washington, GPO, 1956; page 20.)

> "The nostalgic idea that our industrial strength is our greatest military asset could ruin our military planning." (Former Secretary for Air Thomas Finletter in *Power and Policy* (New York: Harcourt, Brace & Company, 1954), p. 256.)

Implication for Natural Resources Policy

What are the implications for natural resources policies and behavior?

The first one, I think, is the opportunity afforded by raw materials for cementing and making strong the free world bulwark against Soviet and Chinese expansion. Unlike ourselves, whose economic welfare does not depend heavily on foreign trade, most other nations must export to continue their present lesser standards of living, let alone advance them:

(a) Exports account for 20 per cent or more of national income in such countries as Australia, Cuba, Egypt, Iceland, Norway, Peru, United Kingdom, and Venezuela; and more than 10 per cent in, for example, Bolivia, Brazil, Colombia, Indonesia, Japan, Mexico, Philippine Islands, Portugal and Thailand.

(b) The importance of the United States–Canadian market to almost all exporting nations is large—for example, more than half the total export market of Bolivia, Colombia, Cuba and Mexico; between one-fourth and one-half of all exports of Brazil, Chile, Peru, Venezuela, Japan, the Philippines and Thailand; and more than 10 per cent of the exports of Norway, Portugal, Turkey, the United Kingdom, Iceland, India, Indonesia and Israel.

(c) Many nations depend primarily upon raw material exports. For example, three-fourths of Bolivia's exports are tin and tungsten; three-fourths of Chile's are copper and nitrates; four-fifths of Cuba's are sugar; one-fifth of Mexico's is lead, zinc and copper; two-fifths of Peru's are minerals; three-fourths of Indonesia's are rubber, petroleum and tin; nine-tenths of Venezuela's total are petroleum; and so forth.

If we accept the opportunity of foreign trade, we not only benefit ourselves economically but also militarily. For we become partners in the economic growth of other nations. Despite some regrettable exceptions, in such partnership with underdeveloped nations there is stimulus to political development along democratic avenues. There is frequently a merging of interest to the point of military alliance, and thereby opportunity for advantageous location of military bases. If we reject international partnership, we may lose more than merely opportunity for gain. Internal economic distress from inability to trade with us may foster growth of undemocratic political parties and institutions, and reduced military establishments for the common defense against Communism. The pressure to export may impel the foreign nation beyond mere arm's length trade with the Communist countries (which in itself is not objectionable) to political and military relations or even dependence. The recent Iceland case, when the free world export markets for its fish (more than 90 per cent of its total exports) collapsed, is relevant. Russia magnanimously offered to buy the fish instead, and Iceland gave notice (since fortunately rescinded) that she was cancelling the United States air base leases there. Finally, except as the free world is welded together economically, the line of demarcation we have drawn to contain Communist expansion becomes blurred, and the area becomes subject to Soviet adventurism, and possible peripheral war.

We might add that in most of the world, United States foreign trade behavior goes beyond immediate economic importance. It is watched as the sign of United States belief in collective defense, and as an earnest of our dedication to the goal of international peace.

The second implication for natural resources has to do with protection against the effects of interdiction of foreign materials supply in the event of recurrence of drawn-out, massive World War II type hostilities. We bypass the questions of likelihood of such war, of diversion of effort to such protection at the expense of other protection, foreign military and political repercussions, of whether arguments for essentiality and prospective shortage of particular commodities are merely convenient rationalizations for private economic interest. To the extent we need protection for this contingency, how should we insure against war-time interdiction of ocean raw materials transport? There are three principles for appropriate behavior here—

(1) maximizing the protection we can get from whatever preparatory costs we decide to incur;

(2) minimizing peacetime interference with the efficiency of the price allocation mechanism of the free enterprise system;
(3) reliance upon ability to ration short goods, particularly luxuries, in wartime.

These argue, in general, in favor of gradual accumulation of raw material stockpiles limited to clearly essential levels, from least cost (usually foreign) sources, in preference to a combination of tariffs or quotas and subsidized domestic raw material production capacity. We get more protection for the dollars we allocate, and without raising market prices to the whole domestic economy. There are, however, two evils that a stockpile program must resist. One is the possibility that its national security purpose will be distorted by political pressures into price support subsidy of particular producers, with consequent damage to the national security program. The second is that unwillingness to contemplate sharply reduced civilian consumption during wartime will result in too lavish estimates of stockpile needs.

There may be a few specific cases in which stockpiles are not an efficient instrument and in which domestic production capacity must be expanded or maintained. There is still considerable choice on principles of least cost and least interference before deciding upon import quotas, tariffs, and widespread supports and other subsidies. In general, maintenance of standby facilities at government expense or subsidy payments to marginal producers only are preferable to overall price supports; and direct measures explicitly covered in the defense budget are preferable to indirect assistance through taxes, tariffs and quotas. But, I repeat, not too much effort or funds should be allocated for insurance against this kind of war.

Why have I emphasized preparations for the World War II contingency, which I think to be unlikely? I have done so because it is for this aspect of national security that government natural resource activities have been most wide-spread and costly. For example, more than $20 billions of tax amortization certificates, a significant portion in the materials industries, have been granted by the government in the past half dozen years in order to induce expansion in domestic industry capacities believed to be necessary for national security reasons. About $6 billions of materials were stored in strategic stockpiles in June, 1956, and the rate of addition at that time was several hundred million dollars per year. The General Services Administration estimated the loss on its inventories of domestically produced manganese and tungsten due to excess of prices paid to encourage domestic production over free market prices, at about $150 millions. And the United States Government is legally obligated to purchase several hundred million dollars of aluminum, which (as of mid-1957) it does not want.

The third implication for natural resources materials has to do with reducing casualties in the event of thermonuclear bombardment of this country. The prevention of mortalities by appropriate combinations of active defense, warning time, dispersal and shelters is not directly related to materials. But survival of the population which escapes death in such attack would be directly related to appropriately located and shielded stocks of food, medicines, water purifying chemicals, fuel, and other materials, which would permit at least primitive survival levels while society undertakes the climb back to civilization. The thought I should like to leave is the possibility that we can afford greater analysis of the materials requirements for post-attack survival; and the possibility that we can afford the accumulation, at protected and appropriate places, of survival stocks.

INISHBOFIN—AN ATLANTIC ISLAND*

T. W. Freeman

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IRELAND'S decline in population has been made possible by the availability of work elsewhere for her people. This article deals with one of the poorest and most isolated districts of the country, an island off the west coast which, for over 60 years, has received government help in various forms, as well as money from relations in America and in Britain. And the island, Inishbofin, has a reasonably contented community not untypical of many in the west of Ireland, all of them Roman Catholic in religion and depending on the priest for the main leadership. Emigration continues, but those left behind and those who return to the island have a leisured way of living rarely encountered in the modern world. As will be shown later, however, the island people maintain their simple but not uncomfortable way of living only by help from outside: if one believes that every inhabited area must make its economic contribution to the state, Inishbofin is a debtor on a considerable scale.

"A small and dwindling population maintain a precarious existence on the Atlantic fringe of our industrial society and present upon the whole an aspect of decline and, in some parts, of dereliction." In these words the Scottish crofting report[1] names a problem, common alike to the Atlantic fringe of Ireland and of Scotland, which was investigated by two Congested Districts Boards, in Ireland from 1891–1923[2] and in Scotland from 1897–1911[3]; in both countries the powers of these boards were transferred to the general administration of agricultural affairs. One by one the islands off the west coast of Ireland are being abandoned[4] but on Inishbofin this prospect does not seem immediate: past and present government assistance has resulted in a planned

*The material for this paper was partly collected during a visit with the Geographical Society of Ireland in July, 1954. The author visited about half the houses on the island of Inishbofin, and for one-quarter of the 96 households recorded the numbers of the household, information on those who had emigrated, the area of the farm, number of stock, methods of selling produce, and other sources of income, such as fishing or work on the roads. Within this range the answers were generally reliable, but no direct financial inquiry would be fruitful and on Inishbofin the number of sheep was almost invariably understated as there are jealousies between households about the use of commonage (see p. 205). In one case a farmer told the writer that he had "half-a-dozen sheep or so" but the following morning he had 23 lined up in his field for the dealer to see. It was impossible to resist the comment over the garden wall, "A fine lot of sheep this morning."

Other aspects of Inishbofin are discussed in three articles in *Irish Geography*, Vol. 3, 1956, pp. 123–135, by J. P. Haughton, T. Jones Hughes, and J. A. K. Grahame.

[1] Department of Agriculture for Scotland, Report of the Commission of enquiry into crofting conditions. H.M.S.O., Edinburgh, 1954, Cmd. 9091, para. 281, p. 87.

[2] For a general treatment, T. W. Freeman: *Geogr. Rev.*, Vol. 23, 1943, pp. 1–14.

[3] Cmd. 9091, 1954, para. 265, p. 81.

[4] T. W. Freeman: *Geogr. Journ.*, Vol. 120, 1954, p. 332.

landscape combined with financial help of such varied forms that one may see the welfare state in action. Inishbofin, four miles beyond the coast of Connemara (10° 10′ W. to 10° 15′ W.), is separated by a strait almost one mile wide from the nearest inhabited island, Inishark. Some of the neighboring small uninhabited islands are useful sheep pastures and others merely reefs dangerous to shipping. In calm weather these islands rise above deep clear waters, but in storms Atlantic waves send spray to a height of 300 feet and more[5] and a dangerous swell sweeps through intricate channels. The inhabitants, farmers and farmer-fishermen are at the mercy of the weather. In 1954 the dry spring resulted in a short growth of oats and barley straw and a feeble growth of potatoes; the fishermen's lobster pots were swept out to sea, replaced and then swept out again; and the hookers could not be taken out in waters always dangerous but vastly more so when the weather consists of an apparently endless series of deep depressions.

Isolation is a major problem, but on four days a week in summer and three days a week in winter a hooker runs from the pier at Cleggan to the island, where it is rarely able to berth at the pier, so that all passengers and goods must be put over the side into a curragh and rowed ashore. In winter the island may be storm-bound for as much as a fortnight at a time, and almost every household has a bag of meal kept for such an emergency. Special arrangements have to be made for the shipment of cattle; fish can be taken for sale to the mainland in rowing boats only during favorable weather; and no eggs are sold owing to transport problems. The range of commodities available on the island is restricted. But the farms are similar to those in Connemara, and the fishing—especially for lobsters—may in some years be distinctly profitable. Peat is still available and no coal is imported. Once the peat is used up, it is hard to maintain existence on these remote islands. And if the population diminishes to very small numbers, its very maintenance may become precarious or impossible as on Inishark (p. 208). Inishbofin's present population is maintained partly by the help of various government schemes, by the remittances of relatives, or—in comparatively few instances—by periodic spells of residence in England to make money as laborers or domestic servants. Incidentally, the people are entirely English-speaking: the Irish speech was lost almost 60 years ago.

Home spinning and weaving of fabrics is now extinct. In 1893, it was noted that most of the clothing was made from "homespun and home-dyed woollen fabrics" but that "imported shop clothes of inferior quality" were replacing them.[6] Inishbofin people have no longer the homespun clothes still worn by the people of the Aran islands in Galway Bay: only one old woman was seen in the traditional red skirt (or petticoat) dyed with imported madder. Clothes are now bought in the local shops, or during occasional visits to Clifden, which is "town" to the islanders, or to Galway, or from mail order houses in Dublin. Even a journey to Clifden involves seven miles in a hooker and seven miles along a road with no public conveyance, and Galway is a further 50 miles by bus as the light

[5] On the cliffs of the island the vegetation is halophytic and consists generally of a low sward of seapink (*Psamma maritima*).

[6] C. R. Browne: The Ethnography of Inishbofin and Inishark, County Galway, Proc. Royal Irish Acad., 3rd series, Vol. 3, 1893–96, p. 354.

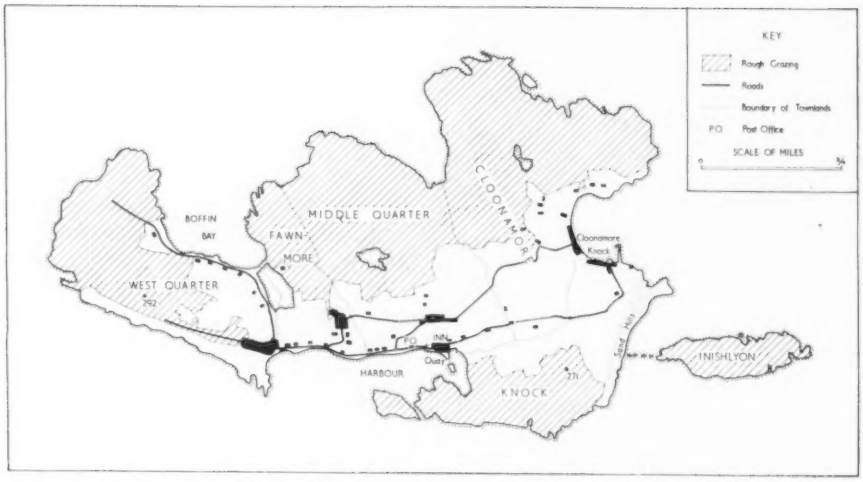

FIG. 1. The townlands of Inishbofin. Inishlyon has no inhabitants, but is used as sheep pasture. Cloonamore and Knock appear as a single line of houses on the shore but are in different townlands. The boundaries of the rough pasture and the distribution of houses were mapped in July, 1954. (Based on Ordnance Survey, 25 inches to 1 mile, Co. Galway, sheet 9, 1898, by permission of the Minister for Finance of Ireland.)

railway was closed in 1925. But the Inishbofin postmistress operates a radio-telephone.

THE LANDSCAPE

Three types of landscape are characteristic: first, craggy hills of no great altitude, with a maximum of 292 feet in Westquarter, 288 feet in Middlequarter, and 271 feet in Knock; second, the farmed rolling countryside ranging from sea level to about 150 feet, and having some natural drainage; and, third, an area of sand dunes and blown sand in the extreme east, once settled and farmed but now used only for rough pasture. The larger of the two lakes, Lough Bofin, is held back by a magnificent shingle ridge in a fine bay, partially protected from strong winds and high seas but open to northerly gales. The coast is rocky almost everywhere and there are some splendid cliffs with outlying stacks: the best harbor is the long inlet on the south side. No recent geological work has been done here, but the original memoir[7] states that the rocks are mainly schists and gneisses, dipping at sharp angles of 30°–89°, much broken by faults and seared by sills and dikes. In short, it is a characteristic pre-Cambrian area. Peat several feet deep is found in the basins between the numerous small hills. Many people cut "scraws," that is, the surface layers of the rough pasture. This time-hallowed practice, noted with disapproval by the Congested Districts Board inspectors 60 years ago,[8] increases year by year the area of exposed rock; it may well be that throughout the peat-consuming areas of Ireland—and of Scotland also—this has happened.[9] As one observer put it, "every

[7] Memoirs of the Geological Survey, Explanatory Memoir . . . sheets 73 and 74 (in part), 83 and 84, Dublin 1876, pp. 39–42.

[8] Congested Districts Board, Base Line Reports, Clifden district, 1891 (and many more such comments in other reports).

[9] F. Fraser Darling: West Highland Survey, London, 1955, pp. 43, 67, 272–276. See especially an interesting survey of what (in Scotland) is called "skinned land" in Lewis by M. Macdonald.

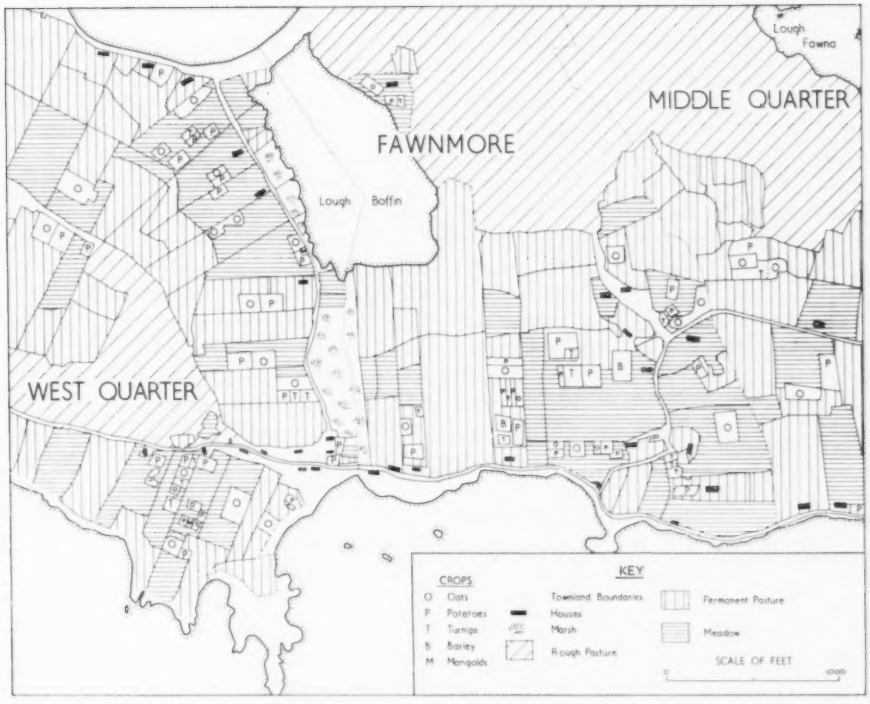

FIG. 2. Land use in part of Inishbofin. The rectangular pattern is characteristic of many areas "striped" by the Congested Districts Board. Small crop "gardens," fields of meadow and improved pasture, exist beside each farmhouse, and roads lead to the "commonage." (Field mapping done by Mr. Clifford Hargreaves, B.A., of the Department of Geography, University of Manchester, in July 1954, to whom grateful acknowledgment is made.)

year the feed of a dozen sheep is burnt in the homes."

Agricultural life depends on the use of the "commonage," or rough pasture, and the improved land, which is almost entirely drift fertilized by seaweed and farmyard manure. Two-thirds of the island's 2480 acres is rough pasture, used for the sheep, cattle, ponies, and donkeys, as well as for peat collection. Figure 1 shows that the island is divided into five townlands, in each of which the commonage is shared, with the result that a farmer may take his animals not to the rough pasture near his holding but to ground as much as a mile away. There is a band of farm lands stretching from lough Bofin to the harbor, and then with no break to Cloonamore on the east side.

This island has a planned landscape. The roads of the commonage pastures and peat bogs have been built under relief schemes and the farms include seven acres of improved land, "striped" or defined by the Congested Districts Board after the land was acquired from its owner, Mr. C. Allies, in 1907.[10] Since then new houses of concrete, with a concrete floor, roofed with asbestos slate or, rarely, ordinary slates, have

[10] Congested Districts Board for Ireland, 18th report for the year ending March 31, 1909, Cmd. 4927, p. 139. The price paid was £8301, including £401 for tenants' interests. Up to March 31, 1915, £7047 was spent on the island, 23rd report, 1915, Cmd. 8076.

been built for almost the entire population. In 1893 it was said that there were no outbuildings or cattle-sheds, so that peat was stacked in a corner of the cottage with the fowls roosting on it, the pigs in a pen beside the fireplace, the cattle in a pen at the other end of the room, and the farm implements and fishing tackle in the rafters.[11] Now the old houses are the outbuildings, still thatched, with oat straw (not rye as formerly) laid on sods and tied down with home-made straw ropes weighted with large stones. Only five thatched houses were still inhabited in 1954. Some of the thatch has sprouting oats and some of it is rotten, but, when a roof is beyond further repair, it is all stripped off and the sodding and thatching begins again. Happily, corrugated iron is not used as it cannot stand the weather.

FARMING

Agricultural practice is almost uniform: an acre or so is divided between oats, potatoes, and—in a few cases—barley, and there is generally a small patch of turnips, mangolds, and, less frequently, cabbage (Fig. 2). Onions, carrots, and parsnips were rarely seen. The ground used for crops is called the "garden," and its fertility is maintained by using animal manure and seaweed, and also by rotating the crops. Strange (or "foreign") seed is favored, and bought at a cheap rate under a government scheme. The remainder of the farmstead consists of a varying amount of meadow, generally 1–3 acres, and some pasture. The precious crops are carefully walled, but some of the farmers open their fields to the cattle and sheep after the harvest, partly as a means of natural fertilizing.

Each farmer has one or two cows and the calves born each year are normally kept until they are two years old, when they are sold either to dealers on the island or to visiting dealers from the mainland. No cattle are slaughtered for meat on the island at present as it pays better to send them on to the fairs at Clifden. The dealers wait for a favorable opportunity of selling the stock and the farmers agreed that these arrangements were far better than individual visits to the fair by the difficult route described on p. 203. The policy of grading up stock, favored by the Congested Districts Board,[12] has been highly successful; there are accredited bulls of the Hereford and Aberdeen Angus breeds available on the island. No butter is sold and little is ever bought. As one of the islanders put it, "You wouldn't understand our ways, sir. If we have a bit of butter over, there's sure to be someone who can do with it, so we just let them have it." Sheep are kept in large numbers and pastured on the common lands; there are probably at least 1000 sheep owned by the farmers on this island. The sheep are sold to the butcher for the island's only meat supply, or to dealers for eventual sale on the mainland, and the wool clip is sold to a Dublin firm which sends a representative to the island in September. No pigs are kept, nor any goats, and each farmer has only a few fowls since there is no way of selling eggs or chickens; only a small number of people have geese, ducks, or turkeys. During the 1914–1918 war, eggs were sold at 3d. each for export, but transport difficulties and the failure to develop any marketing scheme have long since extinguished the trade. The lack of pigs, which may seem surprising,

[11] C. R. Browne, *op. cit.*, p. 355.

[12] W. L. Micks: An account of the constitution, administration and dissolution of the Congested Districts Board for Ireland from 1891 to 1923, Dublin, 1925, pp. 27–33.

is said to be due to the expense of importing feedstuffs. Donkeys and Connemara ponies are kept as draft animals, and almost everything is conveyed in panniers. There are only five carts on the island, of which the first was made in 1907 by a local carpenter from one he had seen on the mainland. The two carpenters make anything required, including lobster pots, fishing nets, furniture, doors, windows, and hand barrows, which consist of two shafts joined by slats and a single wheel in the rear, all of wood.

Digging and manuring of the land begins in late February, and seaweed is brought from the shore as needed. The potatoes are planted about St. Patrick's Day (March 17); oats, two to three weeks later; barley and mangolds at the end of April or in May. Most calves are born from March to May. In dry years peat is cut from May onwards, laid out to dry, and eventually stacked in ricks six feet high secured by large stones, or placed against a stone wall. Apart from routine work, there is little to do until the hay harvest, generally in August or September, though sometimes a cut is made in July (as in 1954) with the hope of a second crop in the autumn. Oats and barley are harvested in September, after which the main potato digging takes place, though some are dug earlier for the household. From October to late February, there is little to do except tend the stock, though some men build walls four feet high at 12/6 a perch or mend roads under government schemes. Few farmers make the ricks of peat beside their houses so commonly seen in Ireland; most fetch it as required.

THE SEA

Encouragement of fishing was a major aim of the Congested Districts Board, and from the eighteen-nineties to the 1914–1918 war both the curing stations were used. The first of these was built by Mr. Allies about 1892 and the second by the Board in 1897.[13] In 1898 during the mackerel fishing season, as many as 75 carts a day passed along the hilly road from Cleggan to Clifden with some 1000 boxes of fish to be sold in Dublin[14]; and in 1912, 8754 cwts. of mackerel, valued at £2211, were landed at Cleggan.[15] The fishermen were "the best and most practical . . . on the west coast" in 1892;[16] today, a large number of men have a curragh (made for £30) and fish for the family, but only four hookers, each manned by five men, are now used in the white fish trade. In good years a man may make £50 or more by trapping lobsters and crayfish, which are stored in tanks in the harbor and in Bofin Bay, then taken for a month's feeding in a vast tank near Cleggan, and finally conveyed over a hundred miles by lorry to the Shannon airport for air transport to Paris. The fishermen receive £3 5s. a (baker's) dozen for crayfish, weighing 5–6 lbs., or £1 15s. for a dozen lobsters, weighing up to 3 lbs. From May to September pots are set round the coasts—a long basket is set for crayfish and a smaller one for lobsters. Some of the dozen or so men in this trade make their own with osiers specially grown, but pots are also supplied by the merchant or made by carpenters. Other marine resources are negligible, though carrageen moss is sold to an agent at 5/– a stone. This naturally gelatinous product, used to make a kind of blancmange, is collected from the rocks between February and August. It is possible

[13] Congested Districts Board for Ireland, 7th Report, 1898, H.M.S.O., Dublin, Cmd. 9003, p. 23.

[14] *Ibid.*, p. 70.

[15] Congested Districts Board for Ireland, 20th Report, 1912, Cmd. 6553, p. 80.

[16] C. R. Browne: *op. cit.*, p. 350.

to collect one stone in an hour. Kelp (seaweed) burning for iodine on the beaches was almost extinct by 1894.[17]

SETTLEMENT AND POPULATION

Of the 96 houses counted as inhabited, 53 are in five hamlets and another six in a loose cluster near the harbor. There is no village as the term is commonly understood, though the main center is beside the harbor, where the inn occupies the one-time "big house" of the Allies family, with the church and the Post Office a short distance away. In all there are eight shops, none of which is recognizable from the outside, as everyone knows them: one is attached to the inn, another to the Post Office, a third occupies a specially built room in a farmyard, and the rest are in front rooms of houses. All the houses except about six have land attached.

Is this nucleated settlement as such? On the first Ordnance Survey map (1838) there were large clusters of houses and on the 1898 map the vast majority of the houses were in clusters. The redistribution of land and building of new houses has broken up many hamlets or made new ones, for example in Knock townland (405 acres) where an old hamlet on a sandy site has been replaced by a new one on drier ground by the shore, with 15 of the townland's 17 houses. In Cloonamore (663 acres) eight houses are placed along the shore and eleven others scattered over the hillside; in Middlequarter (608 acres) there are eleven houses in the main hamlet, six beside the harbor and eleven others at various points beside the shore or on side roads; in Fawnmore (199 acres) six houses out of sixteen are in a loosely defined hamlet; and in Westquarter (523 acres) nine houses out of sixteen are in a similarly formless cluster.

Emigration has entered deeply into the fabric of life: in 1841, Inishbofin with Inishark had 1612 people, but ten years later there were only 1047. A rise to 1236 in 1861 and 1262 in 1871 was followed by a drop to 997 in 1891, when there were 215 families of whom one-quarter were said to be "very poor."[18] Steadily the population declined, to 510 in 1936, 406 in 1946, and 341 in 1951, and now less than 300 (including 40 in Inishark). One-quarter of the families were interviewed in 1954; of these only one-third were "normal families" of parents with children. In the school there were only 29 children aged 5–14, whereas the normal figure would be 48. On Inishark there are now only nine able-bodied men, six of whom are needed to man a boat seaworthy in winter, with the result that an epidemic might be disastrous. Permanent emigration to Britain, or, if possible, to America, is favored by the young and adventurous. Even in 1893 seasonal emigration to Britain as harvesters or domestics was declining,[19] though a number of people went to America for several years, saved money, and returned to the islands. A large proportion of the people have spent several years in the United States. In many cases a family has its older relatives in America, its younger ones in Britain.

CONCLUSION

Having reviewed the economic geography of this island certain conclusions emerge. First, the present relative comfort of the population has been made possible only by past and present government assistance bestowed with lib-

[17] *Ibid.*, p. 349.

[18] Congested Districts Board, Base Line Reports, Clifden district, 1891.

[19] C. R. Browne, *op. cit.*, p. 353.

erality. Houses, farms more than twice the size of those normal before the days of the Congested Districts Board, doles to those needing them from November to April, subsidized schemes of building walls that seem in places scarcely necessary, and no direct taxation—all contribute to the general social welfare. In addition the family allowances and old age pensions help in many households, but these are general state benefits. During the winter many householders are short of money, once the money for the stock has been spent.[20]

Second, emigration has been of vast benefit to the community; money comes in to most of the homes from America[21] or Britain, or both. And emigration has made possible the making of farms which, with the use of commonage, can hardly support a family in comfort but can give basic sustenance; though, as more and more farms are united, some men will prosper, especially those who fish as well as farm.

Third, it is regrettable that the lack of commercial facilities means that eggs, poultry, butter, and other produce cannot be sold; in many parts of Ireland the sale of eggs to grocers and milk to creameries or to dealers brings useful income. The difficulty lies in transport, especially during the winter when the isolation is most acutely felt.

Fourth, remote and isolated as their island may be, some of its people have seen much of the world. It is unlikely that many of the young people will remain here in the future; on the other hand, some former emigrants have come back to rest with thankfulness after their labors elsewhere. As one of them said, "America is a good place for the young, but this is a good place when you're old."

To summarize, Inishbofin now is neither a tragic island nor a romantic enclave of ancient ways. It is an area in which the work begun by the Congested Districts Board has borne fruit, whose people live reasonably well by crofting standards thanks to the help of emigrants and of the state. So long as the fuel holds out, there seems to be no reason why this island should not remain inhabited; but the problems of so curious a population age structure (p. 208) need investigation by a sociologist, and the cost of maintaining this community to the state and its relatives could well form a subject for an economist. For this island is not, and presumably cannot be, self-supporting under modern conditions.

[20] The consumption of stout at the only inn averages eight barrels a week in summer, but only three barrels a week in winter. The standard content of a barrel is 256 pints.

[21] Many of the children are dressed in American clothes.

COMMUNITY OF INTEREST AREAS

NOTES ON THE HIERARCHY OF CENTRAL PLACES AND THEIR HINTERLANDS

F. H. W. Green

Mr. Green, who is now with the Nature Conservancy of Great Britain, has written numerous articles on urban centers and hinterlands, and on bus traffic.

IN reviewing, in the April, 1956, issue of the *Geographical Review*, the 1/625,000 Map of Local Accessibility, with Explanatory Text, published in 1955 by the Ordnance Survey of Great Britain,[1] J. E. Brush remarked that the conception of centers and hinterlands of different orders of importance, or of magnitude, had not been made very clear.[2] Since the map was mainly designed, and the text partly written, by me, I have attempted in the present paper partly to make good this omission.

The idea of five main orders, from metropolis to "service village," has been fairly widely, if only tacitly, accepted, and this would not have been so if something corresponding approximately to this hierarchy had not been found practically useful and recognizable. Even workers with whom geographers have little contact, such as Lee R. Dice,[3] have recognized this kind of hierarchy. Dice, in the jargon of ecology, uses the terms "homestead ecosystems," "village-centered ecosystems," "town-centered ecosystems," "city-centered ecosystems," "national ecosystems," and "international ecosystems," which have replaced older "tribal ecosystems."

One type of center and hinterland has in recent years been much more intensively studied than others; this has been the "fourth order." It is useful to consider first of all why this should have been so.

The Theoretical Pattern

A good starting point can now be found in the writings of August Lösch,[4] which have recently become more accessible to the reader of English by the translation of his *Economics of Location*, which was published by Yale University Press in 1953. The theoretical part of Lösch's book is not easy reading, but careful study reveals much that is more useful in the geographical study of areas than is found in the now classic writings of Christaller.[5] An attempt will be made in the following paragraphs to summarize Lösch's thesis so far as it is relevant to our subject.

Lösch postulates that each individual product or service has an optimum "marketing area," which is determined primarily on a profits basis. Since an inhabited region has customers distributed more or less over the whole of its surface, the whole region will

[1] Ordnance Survey of Great Britain: "Local Accessibility" map in 1/625,000 Planning Series, with Explanatory Text, Chessington, 1955.

[2] J. E. Brush: "The Urban Hierarchy in Europe," *Geogr. Rev.*, Vol. 43, 1953, pp. 414–416.

[3] Lee R. Dice: *Man's Nature, Nature's Man*, Ann Arbor, Mich., 1955.

[4] August Lösch: *Economics of Location*, New Haven, Conn., 1953.

[5] Walter Christaller: *Die Zentralorte Süddeutschlands*, Jena, 1933.

need to be covered with marketing areas, and, in accord with well-known and generally understood principles, these will tend to assume a hexagonal shape. For each product or service there is, ideally, covering the "economic landscape" a lattice of regular hexagons of a certain size.

If we have lattices of hexagons for each such purpose, it is easy to see that these can be superimposed upon each other in a multitude of ways, depending primarily on whether the sides of the hexagons in the various lattices are parallel to each other or not. But however much the lattices are, as it were, dropped down at random on top of each other, there will be some places where the centers of hexagons coincide. At one point, they may even all coincide, while at other points two or more, but not all, will come together. The rare point where all do come together is the metropolis of an economic landscape or region.

The points where the centers of smaller hexagons coincide will be relatively frequent in occurrence, and this is in accord with the relative ease with which local and district centers and hinterlands have in practice been found definable. Speaking loosely, there is nothing significant, smaller in size, for them to coincide with. In the case of the lattices of hexagons at the opposite end of the size scale, coincident centers will in the nature of things be comparatively rare, and this makes them in practice fairly easily identifiable. It has been found at least in Britain that provincial capitals can be identified, and their hinterlands defined, without much greater difficulty than is encountered with local and district centers.

But it begins already to be apparent why centers and hinterlands of the middle orders of importance are relatively difficult to define. Their counterparts in Lösch's theory are hexagons of medium sizes; while one may not infrequently find centers of two, or three, hexagons of medium size coinciding in the superimposed lattices, these will not always be the same two, or three, sizes of hexagons. *Regional*, or *third order*, centers may thus be said to differ in kind, as well as importance, from one another.

We have so far been considering, with Lösch, an "ideal" economic landscape, i.e., one in which human activities are more or less evenly distributed, because, most probably, of a relatively homogeneous physical background, in a certain historical phase of occupance and exploitation. But such landscapes are not commonly met with in a changing world. In the English Midlands for example we find not only variations in the geological and topographic scene, but traces of several phases of economic exploitation; a once almost exclusively agricultural landscape has had an industrial landscape grafted on to it, without the two having yet become completely fused.

Lösch's theories do, however, take into account the junction lines, where they are recognizable, between different economic landscapes; these may for instance occur where the physical background changes significantly, and has thus given rise to a different pattern of human occupance, or where different administrations have imposed certain differences in habits. To make use of Lösch's concepts is emphatically not to discount the importance of physical geography; the physical environment is fundamental, and adequate discussion of *economic* landscapes presupposes adequate knowledge of it.

There is one important point which Lösch admits to not having embraced in his theoretical exposition. It is that market centers themselves, when

they have become towns, are in terms of population a significant proportion of their own hinterlands. They may even dwarf the "rural" hinterland completely. The differing sizes of centers, expressed usually in terms of population, cause the hinterlands to be eccentrically disposed about them; a simple rule relating to this is commonly referred to as Reilly's Law.[6] In a sense, however, Lösch's concept of different economic landscapes does allow for this eccentricity, though he himself has not claimed that it does; if a town has smaller towns in the country to one side of it than to the other, it can be said to be at the junction of two economic landscapes, and can consequently have a hinterland which is irregularly shaped. Reilly's Law and its variants, however, remain very useful practical rules.

It would not be appropriate, or even necessary, in this paper to give an account of different types of economic landscapes, but it may be useful to mention one type of regional variation which may not be particularly well known. The buying habits of people can vary. It has been pointed out by both Fleming[7] and Green,[8] that the annual sales from retail stores per head of the population is relatively constant over most of Britain, even though Wales is somewhat differentiated from England and Scotland possibly because of differences of custom and habit, which would repay investigation. Similar regional differences can be traced in the United States, as shown for instance by P. D. Converse in a Study of Illinois.[9] After adjusting for the differences in purchasing powers of money, the sales per head of the population seem to be about the same as in Britain.[10]

It is particularly important to notice that the figures for sales per head over areas the size of large counties (including their associated county boroughs, or in Scotland, counties of cities) are, in spite of the interesting slight deviations mentioned above, sufficiently uniform for us to be able to make deductions concerning individual towns which show varying amounts of departure from the county or national averages. This is fundamental to some of the argument which follows.

THE FIRST ORDER

Little will be said here about the metropolis, or first order center. In most countries, there is one outstanding center which is immediately recognized as such. Paris in France and Brussels in Belgium, are archetypes. In Great Britain, London is unchallenged, even though Edinburgh and Glasgow jointly perform certain limited functions of a metropolitan character in Scotland. In some other countries, the metropolitan function is shared, as in New Zealand, between several cities of almost equal significance, but this is clearly seen to be only a modification, albeit an important and interesting modification, of the general case. In countries of large

[6] W. J. Reilly: *The Law of Retail Gravitation*, New York, 1931 (published by the author). This "law" has been formulated, apparently independently, by Continental writers, and a variant of it has recently been put forward by J. D. Carroll, Jr., in the *Traffic Quarterly* of April, 1955, pp. 149–161. This relates the effect of distance, not to an exponent of 2, as suggested by Reilly, but to 2.8, i.e., the attraction is according to approximately the cube of the distance rather than its square.

[7] J. B. Fleming: "An analysis of shops and service trades in Scottish towns," *Scottish Geogr. Mag.*, Vol. 70, 1954, pp. 97–106.

[8] F. H. W. Green: "Community of Interest and Local Government Areas," *Public Administration*, Vol. 34, Spring, 1956, pp. 39–49.

[9] P. D. Converse: *Retail Trade Areas in Illinois*, Business Studies, No. 4, University of Illinois Bulletin, 1946.

[10] Lady Hall and J. Knapp: "Numbers of Shops and Productivity in Retail Distribution in Great Britain, the United States and Canada," *The Economic Journal*, Vol. 45, No. 257, March, 1955, pp. 72–88.

area, which have a federal constitution, it is possible to recognize several places which have some metropolitan features, but in the United States these should not be identified with the central cities of standard metropolitan areas as delimited by the United States Bureau of the Census.

THE SECOND ORDER

There are certain towns in Britain which would be accepted by all as provincial capitals, or second order centers. To start with the comparatively simple case of Scotland, there are the four cities of Aberdeen, Dundee, Edinburgh, and Glasgow. Here there is a striking superficial resemblance to New Zealand, the respective analogues being Christchurch, Dunedin, Wellington, and Auckland. Certain metropolitan functions are indeed found in Edinburgh and Glasgow, the former, like Wellington, being primarily administrative, and the latter, like Auckland, primarily commercial. As a second order center Dundee is of the Scottish four the only one open to doubt. Its second order hinterland is relatively small, and, as Fleming has shown, its retail facilities are not fully consistent with second order status, but it does, like the other three, publish a daily morning newspaper.

Gilbert[11] has summarized previous work on the provinces of England and Wales, while Smailes[12] has put forward a basis for classifying "Major Cities." Smailes uses a number of different criteria, but, as in Scotland, one finds the publication of a daily morning newspaper to be the single guide most closely in accord with the usual opinion of informed people. With the recent passing of a morning daily published in Brighton, only three towns—Doncaster, Ipswich, and Leamington Spa—remain as anomalous possessors of such a publishing activity. Bradford and Sheffield, however, are large industrial towns which possess their own newspapers, but which, particularly Bradford, are lacking in rather too many other attributes of a provincial capital to find a place in a final list, unless, in the case at least of Sheffield, one concedes that a place may be a third order center which fulfils second order functions for its third order hinterland.

There are in England and Wales, three places, with daily morning newspapers, which are by no means as large as a number of towns which are without. These are Plymouth and Norwich in England, and Cardiff in Wales. The two English ones are in peninsular positions, distant from other large centers. Following Lösch's theories, one could well expect to find a large number of hexagon centers coinciding at certain points thus distant from their peers. But their peninsular positions inevitably restrict their hinterlands, and so they do not compare in population served with other second order centers. Cardiff owes its importance to being the focus of the densely populated area of South Wales, separated by the Bristol Channel from Bristol. The Bristol Channel, at least its upper reaches, is as much a barrier as a line of communication, and may be said to have hindered the development of a second order center properly independent of London. Bristol barely holds its own, while it is doubtful whether Cardiff has much more hold over West Wales than has London. According to the rules expounded by Reilly and Carroll, the southwestern counties of Wales should theoretically

[11] E. W. Gilbert: "The boundaries of local government areas," *Geogr. Journ.*, Vol. 111, 1948, pp. 172–198.

[12] A. E. Smailes: "The Urban Hierarchy in England and Wales," *Geography*, Vol. 29, 1944, pp. 41–51.

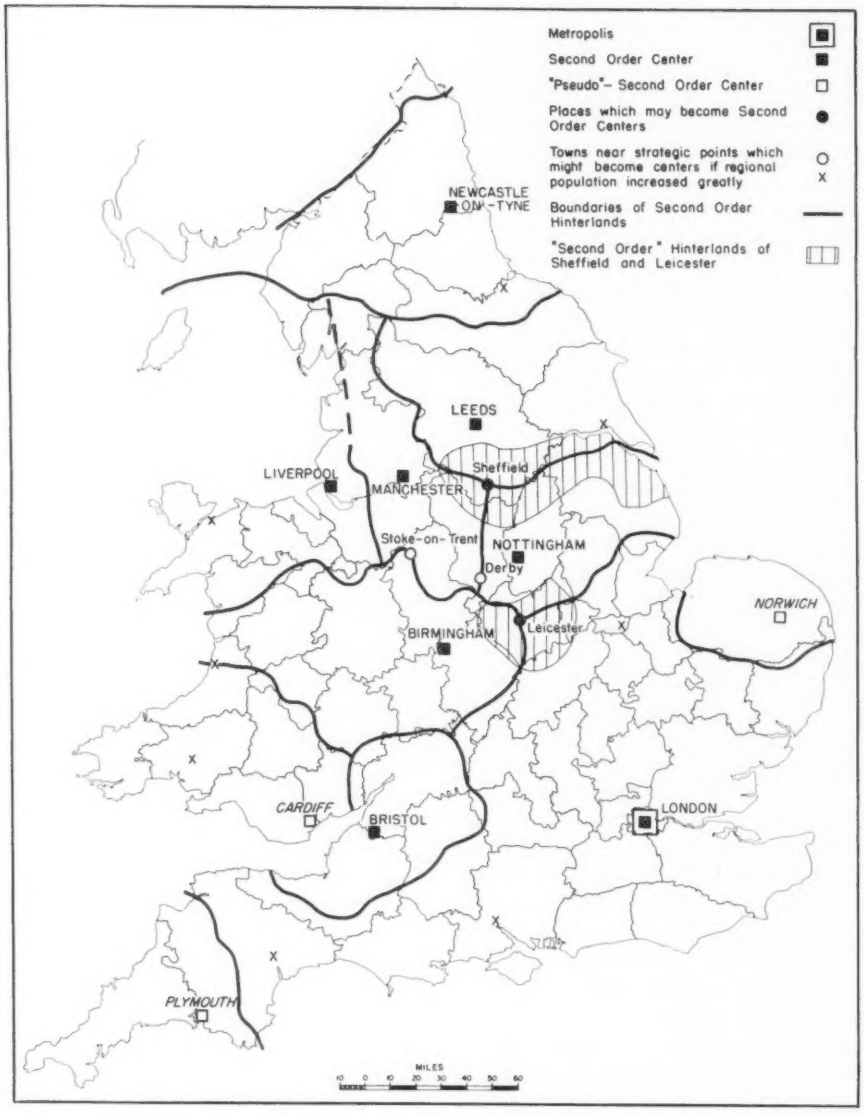

FIG. 1 Second order centers and hinterlands in England and Wales.

fall within the hinterland of London rather than of Cardiff, and this is supported in practice by the fact that it takes much longer to reach Cardiff from them than it does to continue on to London by fast train from the latter; it is not merely epigrammatic for London to claim to be the capital of Wales!

Study of road passenger traffic bears out the general conclusions of educated opinion, as well as the validity of the specific criterion of daily newspaper

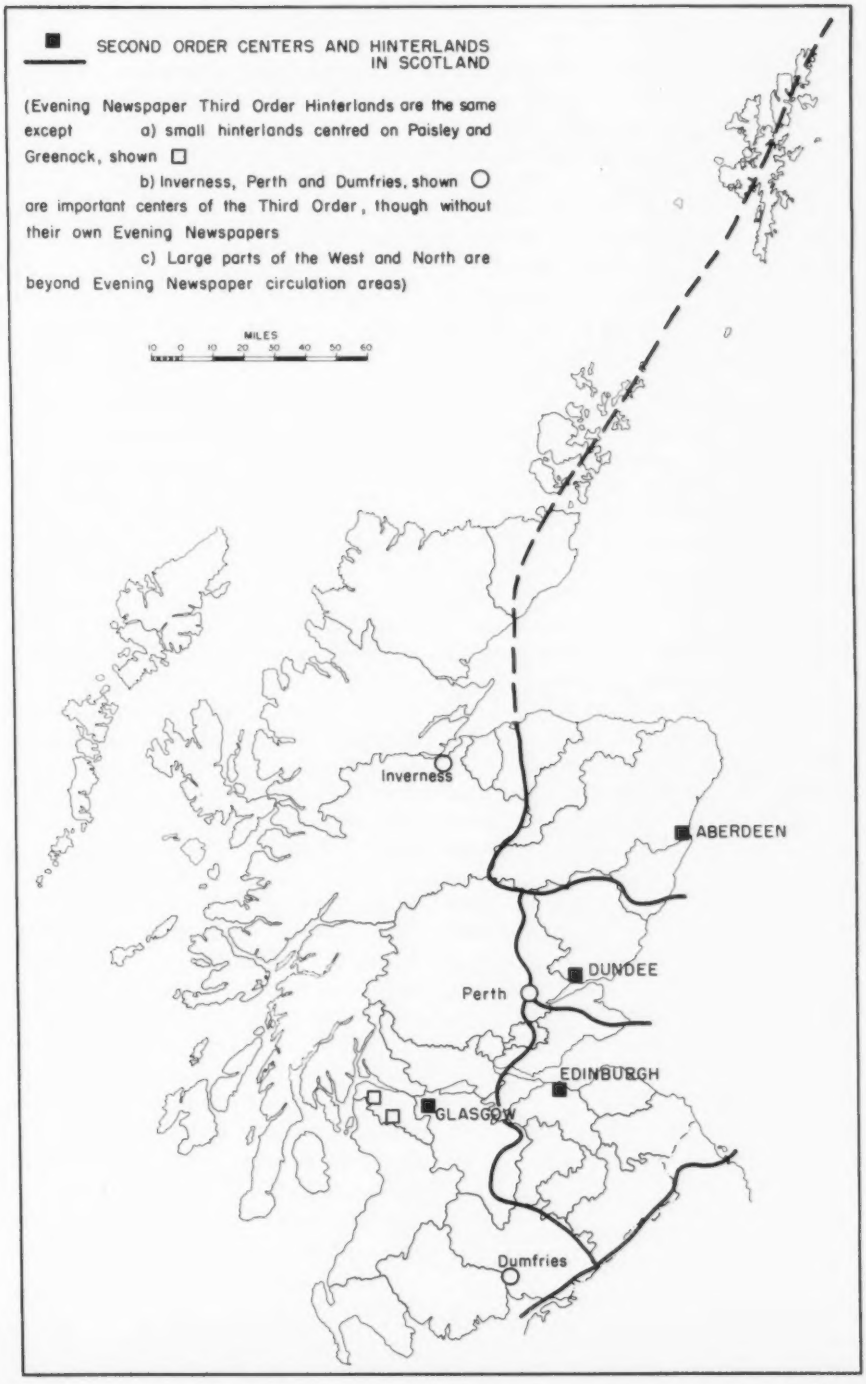
SECOND ORDER CENTERS AND HINTERLANDS IN SCOTLAND
(Evening Newspaper Third Order Hinterlands are the same except a) small hinterlands centred on Paisley and Greenock, shown
b) Inverness, Perth and Dumfries, shown are important centers of the Third Order, though without their own Evening Newspapers
c) Large parts of the West and North are beyond Evening Newspaper circulation areas)
MILES
10 0 10 20 30 40 50 60
Inverness
ABERDEEN
DUNDEE
Perth
EDINBURGH
GLASGOW
Dumfries

FIG. 2. Four cities of Scotland and hinterlands. Evening newspaper publishing centers also shown.

publication. Figures 1 and 2 show second order centers and their approximate hinterlands, and on Figure 1 also are named certain towns which may in the future come to qualify by common consent as provincial capitals.

THE THIRD ORDER

Starting from a suggestion made by Green,[13] W. I. Carruthers has made an investigation of the possibilities of using road passenger transport services to define second and third order centers and hinterlands in England and Wales. He has summarized the results in a recent paper.[14] Briefly, he has first of all classified centers on the basis of (a) the numbers of bus and coach services to and from them, and (b) the proportion of such services which serve no places larger than the centers themselves. By methods similar to those used for delimiting fourth order hinterlands, but with certain elaborations, he has then defined the second and third order hinterlands. His paper is of particular interest in relation to third order centers, which he has found it necessary to subclassify into four types, which he connotes as 3A, 3B, 3C, and General, third order centers. There is little doubt that he has extracted as much information on centers of this order as it is possible by such methods to do, but one is left with the strong impression, which is in accord with Lösch's thesis, that not even with this subdivision, are the functions of 3A, 3B, and 3C centers as homogeneous as those of fourth order centers, which he incidentally subdivides also. The General third order centers are places, usually industrial towns, such as Bolton, Lancs., or Huddersfield, Yorks., whose third and fourth order hinterlands are co-terminous: they could be described as "self-contained" fourth order centers, which are equipped to perform their own third order functions. This self-sufficiency helps to explain the characteristic "rugged provincialism" of the inhabitants of places of this type. Generally speaking, Carruthers' third order centers coincide with Smailes' cities and major towns, but there are discrepancies similar to those found between fourth order "bus centers" and Smailes' towns and sub-towns.

A commercial map publishing firm[15] recently inquired if a map of Britain could be produced showing second and third order centers and hinterlands comparable with the 1/625,000 Ordnance Survey map, which portrayed in effect fourth order centers. Their problem was to produce a map which would have the same kind of appeal to sales managers and advertising concerns as did the latter map. Examination of this problem showed that, as far as third order centers were concerned, this could be done only if one defined *what kind* of third order centers were to be portrayed, and that even then there would be certain *caveats*. It was eventually decided that the most useful centers to be shown would be newspaper publishing towns. Since daily morning newspapers are almost exclusively published only in provincial capitals, i.e., second order centers, and many weekly newspapers emanate on the other hand from places which are only minor centers, it was decided to make daily evening papers the criterion. These are published in 59 towns in England, two in Wales, and

[13] F. H. W. Green: "Bus Services as an Index to changing Urban Hinterlands," *Town Planning Review*, Vol. 32, No. 4, January, 1952, pp. 345–356.

[14] W. I. Carruthers: "The Classification of Service Centers in England and Wales—an analysis of public road transport services," *Geogr. Journ.*, Vol. 122, 1957, pp. 371–385.

[15] "Geographia" Ltd., of London: the map will be published in their series of "Marketing Areas" maps and handbooks.

six in Scotland, as shown in Figures 2 and 3. These towns are much more irregularly distributed than are fourth order centers, and even if one excepts the Home Counties their density is only very roughly proportionate to the density of population. Intertown distance is a factor, as it is with fourth order centers, but it is not by any means the predominant factor.

Certain resorts, such as Brighton, Bournemouth, Torquay, and Scarborough, publish evening newspapers, and so also do some seaports, including comparatively small centers like South Shields and Greenock. Then there is such an apparent anomaly as an evening newspaper unexpectedly published in Nuneaton. Yet even including all these places, there are surprisingly few centers which would not appear as third order centers by alternative criteria. For example, the towns tentatively selected as third order centers in the West Riding of Yorkshire, by considerations of general wholesale and retail distribution functions,[16] coincide exactly with the evening newspaper centers. Again most of the evening newspaper towns are the towns with more than the regional average sales per head of population in the retail furnishing trade. This correlation is almost certainly not fortuitous; furniture shops are extensive advertisers in local papers. The position of certain seaside resorts is noticeable in the furniture trade map. Even though their high sales per head for town plus fourth order hinterland is partly explained by their often small hinterlands, this by no means entirely explains it. In looking for other reasons, one considers their residential function (which they share with suburban centers) and their periodic visitors on holiday, with leisure to inspect those comparatively expensive items of furnishing which are not purchased frequently by any one family.

The maps (Figs. 2 and 3) show hinterlands as well as centers; indeed the portrayal of hinterlands was an objective of the publishing firm. These hinterlands are based on accessibility in a similar manner to the map of fourth order hinterlands, though in this case trains and long distance coaches have been taken into account, as well as some regard to traffic on main roads. The boundaries are less precise than as shown on Figure 3, but this is because on the map they were made to coincide as far as possible with fourth order hinterlands (exceptions to this are shown by dashed lines). The areas shown are thus "accessibility hinterlands." They are not drawn as the areas in which the respective evening newspapers have dominant sales, though there is every reason for believing, *a priori*, that such areas will tend to coincide with the accessibility hinterlands; personal knowledge of various parts of the country goes towards confirming this belief, and so does Table I, showing the relationship between the newspaper circulations[17] (where known) and the populations in the hinterlands. The circulation per head is calculated on the basis of the whole population of the hinterland, and is expressed as the number of copies sold per 100 persons. In some cases the hinterland includes distant, and rural, areas, where comparatively few evening papers are sold at all, and this accounts for low figures in the case of papers published in such places as Plymouth and Exeter. Where the hinterland is limited in area, and

[16] F. H. W. Green: "Community of Interest and Local Government Areas," *Public Administration*, Vol. 34, Spring, 1956, pp. 39–49.

[17] The Newspaper Society: "Advertisers' Aid," published twice yearly, London.

FIG. 3. Evening newspaper publishing centers and their hinterlands. (Reproduced by permission of "Geographia" Ltd.)

TABLE I

CIRCULATIONS OF PROVINCIAL EVENING NEWSPAPERS

Blanks appear where circulation is not published. Where more than one evening paper is published, the circulations have been added together

Name of town	*Number of copies sold per 100 persons in hinterland*	*Name of town*	*Number of copies sold per 100 persons in hinterland*
England		Newport (Mon.)	15.9
Barrow-in-Furness	24.4	Northampton	27.8
Bath	....	Norwich	11.9
Birmingham	17.0	Nottingham	.....
Blackburn	22.7	Nuneaton	....
Blackpool	29.4	Oldham	27.0
Bolton	26.3	Oxford	12.7
Bournemouth	16.4	Plymouth	10.8
Bradford	20.8	Portsmouth	19.2
Brighton	15.9	Preston	32.2
Bristol	25.6	Scarborough	21.7
Burton-on-Trent	18.2	Sheffield	15.9
Cambridge	....	Shields, South	31.3
Carlisle	11.1	Shields, North	22.7
Cheltenham	26.3	Southampton	20.0
Coventry	21.7	Stoke-on-Trent	21.3
Darlington*	9.6	Sunderland	20.8
Derby	23.8	Swindon	20.8
Exeter	11.8	Torquay	13.3
Gloucester	15.6	Weymouth	14.7
Grimsby	34.5	Wolverhampton	33.3
Halifax	25.6	Workington	.....
Hartlepools	27.8	York	25.0
Huddersfield	23.8	*Wales*	
Hull	25.6	Cardiff	19.2
Ipswich	....	Swansea	10.9
Kettering	....	*Scotland*	
Leeds	27.8	Aberdeen	19.2
Leicester	32.2	Dundee	....
Lincoln	17.5	Edinburgh	14.1
Liverpool	19.2	Glasgow	21.3
Manchester	23.8	Greenock	20.0
Middlesbrough	29.4	Paisley	....
Newcastle-upon-Tyne	22.2		

*The anomalously low figure for Darlington, and also the relatively high figure for Middlesbrough, appear to be explained by the fact that the Bishop Auckland area is served by an evening newspaper, now printed only in Middlesbrough, which was formerly printed also in Bishop Auckland. By most other criteria, the latter town would certainly be placed in Darlington's sphere of influence.

includes a dense urban population around the publishing center, the figure is much higher, as in the case of Leicester or Oldham. But on the whole, the departures from the median figure of 21.3, which happens to be the figure for the London hinterland, are quite small.

The map shows how the apparent dominance of the London papers extends farthest in two areas of low population density. Although this can be regarded as a realistic representation, the sales of any evening newspapers are low in these areas. Somewhat similar circumstances arise in the case of other hinterlands, and sales are known to be almost nil in many parts of Scotland and Wales and a few parts of England; the evening newspapers could not arrive in time to compete effectively with national or provincial dailies, or with local weeklies.

The grade of towns in Carruthers' study which most nearly coincide with the evening newspaper centers is his type 3A. The major difference is that 3A centers occur in the area served with London evening papers at about the same distances apart as in the rest of England. That these 3A centers differ in kind from the others not only

in leaning on London for this service, is indicated by the fact that few of them are outstanding as furnishing trade centers. Anyone who has lived in any of them knows that they have not the range of shopping facilities to be found in most of those which lie beyond the second order ambit of London. Moreover, the degree to which the more traveled persons in these towns focus their social activities on London is realized by the North Briton when he speaks of the "Home Counties Englishman."

This brief discussion of several different *kinds* of third order center and hinterland (viz., transport, furniture, and evening newspaper centers) will have served to illustrate the variety of functions performed by towns of intermediate size and importance. The third order embraces thus highly varied groups which nevertheless clearly stand between the second and the fourth order, the justification for giving it the overall name of third order being that it is not readily sub-classified on a basis of comparative importance.

THE FOURTH ORDER

Fourth order, or *district*, centers have received far more attention than most. They and their hinterlands are relatively easy to define, largely for reasons given in discussing Lösch's thesis above. Although they do indeed vary in kind, there is a good deal of common ground in their various functions. In general they are places which individual people, or at least representatives of families, need to visit about once a week. Shorn of only one or two of the functions they mainly share in common, they can be recognized from the hearts of conurbations to the wide spaces of the American Great Plains[18] or the South African Karroo.[19] It has been amply demonstrated that their distribution is governed much more by the distance, which is to say the time, factor than by the population factor, and they tend, over a wide range of population densities, to be somewhere in the order of 10 to 20 miles apart. Only at the extremes of population density is the distance greatly exceeded or diminished. The 1/625,000 Local Accessibility map, which does in general represent what would be defined on other grounds as fourth order centers, shows that the reduction in areal size of the hinterlands in the densely populated areas of Britain is not nearly commensurate with the population differences. Table II gives some indication of the correlation between hinterland populations and the population densities of the region. In the special case of the built-up London region, a map, shown as Figure 4, was constructed to show the main suburban shopping centers, and it will be seen that here the distance apart of the centers is about four miles, and the population served averages about 120,000.

Among all the European (and Europeanized) countries studied, the Republic of Ireland stands apart on the basis of hinterlands defined by public transport accessibility;[20] it is even sharply contrasted with Northern Ireland. Centers are fewer, and hinterlands larger in area than would be expected. This cannot be due solely to the shortcomings of the method; there is plenty of evidence that lack of use of public transport is not compensated for by increased use of other means of transport. There is, however,

[18] J. E. Brush: "The Hierarchy of Central Places in Southwestern Wisconsin," *Geogr. Rev.*, Vol. 43, 1953, pp. 380–402.

[19] Hans Carol: "Das Agrargeographische Betrachtungssystem," *Geographica Helvetica*, 1, 1952, pp. 17–67.

[20] F. H. W. Green: "Community of Interest Areas in Western Europe," *Econ. Geogr.*, Vol. 29, 1953, pp. 283–298.

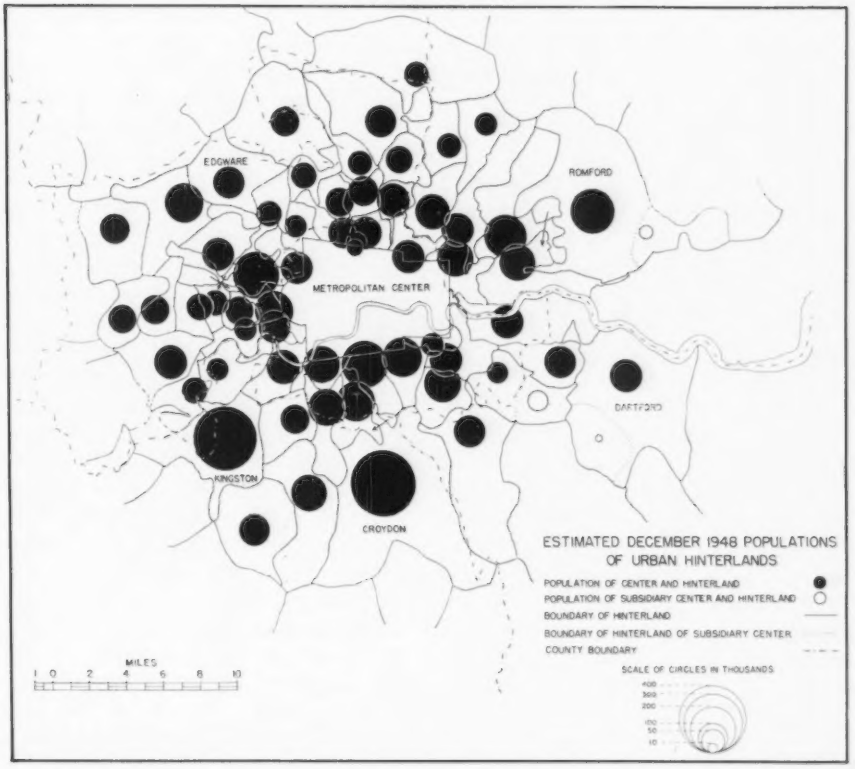

FIG. 4. Hinterlands of Greater London's chief shopping centers, with estimated populations.

in many parts of Ireland much less total purchasing expenditure per head of the population than is normal in western European countries. An agricultural district there does not in general support nearly as much *secondary* population, fulfilling its needs, as do agricultural districts elsewhere. In England, for example, the ratio of *secondary* to *primary* population appears to be about 2:1 in a purely agricultural district, and Dutch workers have suggested the same ratio in the Netherlands; in the west of Ireland, as Freeman has pointed out,[21] the ratio may be as low as about 1:9. In the east of the country (County Meath and County Dublin) it may still be as low as 2:3; even though it is true that this may be masking the fact of a large secondary

[21] T. W. Freeman: "The Irish Country Town," *Irish Geography*, Vol. 3, 1954, pp. 5–14.

TABLE II

HINTERLAND POPULATIONS AND POPULATION DENSITY

	Population of hinterland	*Average density of population per sq. mi.*
South Central Wisconsin (Brush)	4,000	20
Scotland, excl. Glasgow Dist. (Fleming and Green)	6,000	125
France, 5 South-Eastern Dept. (Green)	10,000	140
England and Wales, excl. Chief "Conurbations" (Green)	16,500	470
Belgium (Green)	49,500	750
Greater London (Green)	120,000	15,000

population gathered in the City of Dublin, the figures are striking enough. Spain and Portugal may prove to be counterparts of the Republic of Ireland, but, owing to lack of readily accessible data, comparisons are not easy to put into quantitative form. It is clear, however, that here is a matter of great sociological interest and importance. One can agree with E. Estyn Evans[22] that Ireland illustrates the view, which is rather obscured in its neighbors, that "the fair precedes the town and was one factor in its rise." On a fair day in Ireland, "the country takes possession of the town, and one is clearly in the presence of a force older and more fundamental than the town which has given it hospitality." In other western European countries the town has become a more fully developed permanent focus, and not an intermittent or temporary one: this fact has tended to make many people forget that the area of community of interest is more fundamental than its center. Ulster is distinguished from the rest of Ireland by the greater steps which its towns have taken along the road towards being essential and permanent foci, which influence the countryside.

An important document which appeared in 1953 is the "Rural Community Structure" section of the Survey Report for the East Sussex Development Plan, which was prepared by Jay and Hirsch.[23] In this report an admittedly arbitrary but not unreasonable classification was made, on the basis of services provided, into four types of center in East Sussex (the lowest orders being neglected). These are, following Smailes, called: Urban Village, Sub-Town, Town, City. The hinterlands of each of them were defined by the use of an "Accessibility Index," which gave weight not only to frequency of public transport available, but also to early morning and late evening train or bus facilities, and length of walk to and from bus stop or railway station. The resulting maps are shown in Figure 5.

One of the interesting things which this Survey shows is that while all the larger centers perform to some extent the same functions as the smaller centers, the sizes of the areas thus served vary considerably. Careful scrutiny of the sizes of the hinterlands on these maps shows that Hastings is important at all four levels, whereas Brighton serves comparatively small areas except at the "City" level, where it comes suddenly into its own. In Lösch's terminology, one could say that centers of only the smallest and the largest hexagon lattices, of the four in question, have centers coinciding in Brighton, whereas all four may have centers coinciding at Hastings. In the case of Heathfield, only the "Urban Village" and "Sub-Town" lattices have coincident centers, while at Hailsham the maps suggest that it is the "Urban Village" and "Town" lattice centers which coincide.

At this point one should, and conveniently can, make reference to the *Higher* and *Lower District Centers* of Bracey and Brush.[24] These centers were defined in a comparable manner to the fourth order *Accessibility Centers* of the 1/625,000 Ordnance Survey map, and can in most respects be identified with them. But the two writers produce some evidence that there is a significant break in the sizes of their hinterlands

[22] E. Estyn Evans: *Irish Heritage*, Dundalk, 1949, p. 159.

[23] L. S. Jay and G. P. Hirsch: "Rural Community Structure," in Survey Report "A", Part III, East Sussex Development Plan, February, 1953.

[24] J. E. Brush and H. E. Bracey: "Rural Service Centers in Southwestern Wisconsin and Southern England," *Geogr. Rev.*, Vol. 45, 1955, pp. 559–569.

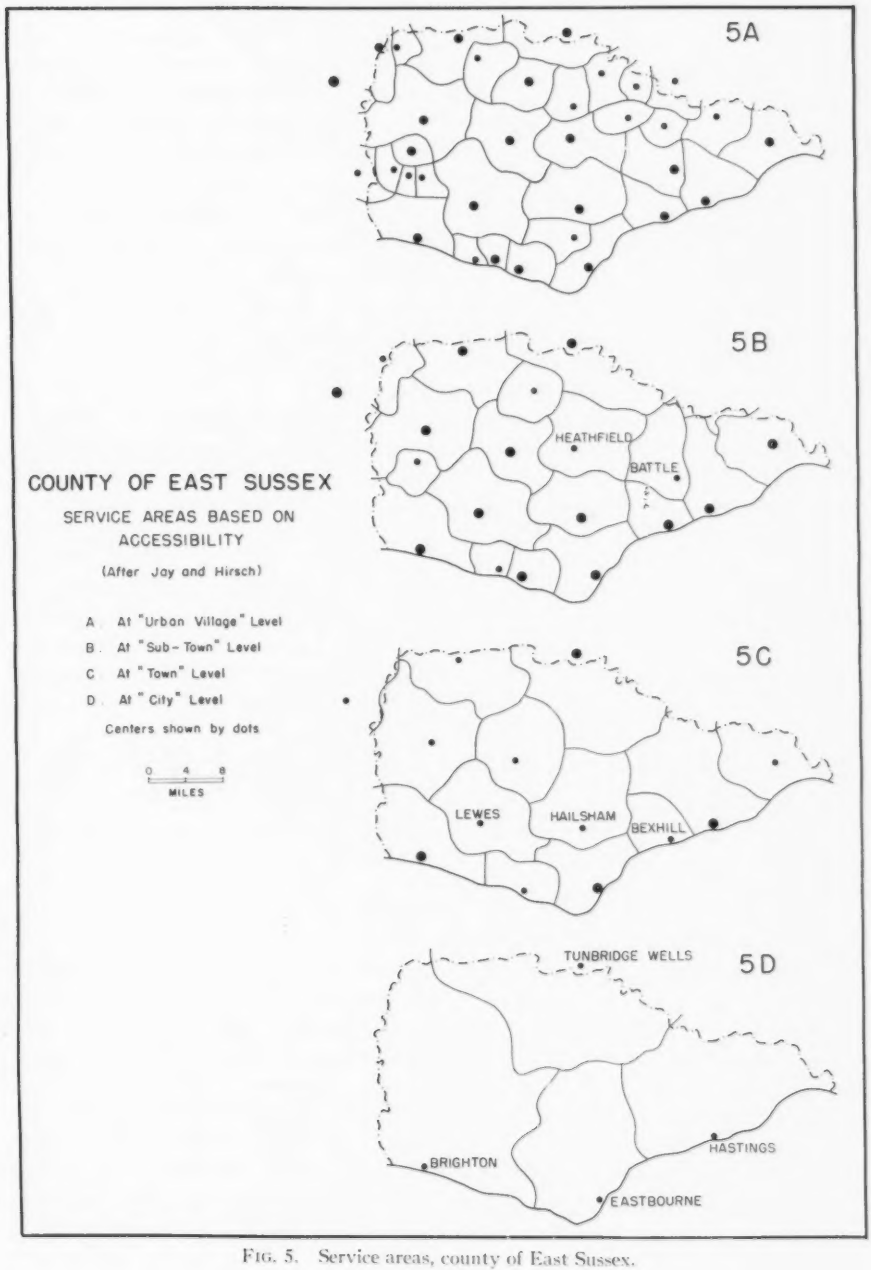

FIG. 5. Service areas, county of East Sussex.

corresponding in Wisconsin[25] to a population in the center of about 1000 and a distance apart of about 10 miles; those below this population are more numerous, and those above less numerous, than would be the case if there were a simple straight line relationship between numbers of centers and population.

It is highly significant that, although the sizes of the populations of the centers are very different in Wisconsin as compared with southern England, the distances apart of, and areas served by, the centers are remarkably similar. Thus, while the mean population of the service area of a Higher Order center (including its own population) is 5770, and in southern England is 47,030, the average areas served are as similar to each other as 129 and 128 square miles respectively.[26]

Lösch, like Christaller, makes reference to the inter-relation of the most economic transport system to the alignment of the hexagon lattices. Lösch shows that ideally there is a tendency for the lattices to be superimposed on each other in such a way that alternate sectors round the metropolis—or other major center—have maximum and minimum numbers of common centers of hexagons of different sizes, i.e., there are radiating belts with many towns, or many large towns, alternating with belts containing few towns, or only small towns. In the newly developing Middle West of North America, which has a comparatively simple history, it is possible to recognize these populated sectors or belts, clustered near to the transport routes, which radiate like spokes round the metropolitan wheel-hub. Britain is too far removed from a simple ideal economic landscape for this refinement to be easily recognized in practice, but one does wonder whether the sometimes recognizable "alignment" of Higher and Lower District Centers is a slight symptom of this tendency at work. There is not only a suggestion of it, on one scale, along the main railway lines radiating outward from London, but it appears to be shown on a smaller scale on, for example, the maps of East Sussex. Approximately west to east across the center of that County is a belt of towns with hinterlands at several levels of importance, while parallel with them to the north is a belt of centers most of which command hinterlands only at the "urban village" level. These two belts are readily correlated with good through routes, including a main line railway, in the one case, and in the other case the much dissected country of the High Weald which has always been a physical deterrent to the development of communications. Between the two more distinct belts can be noted several centers which rise only to the "sub-town" level.

A study of Bracey's and Brush's Higher and Lower District Centers suggests that in some cases they roughly correspond respectively to the East Sussex "towns" and "sub-towns." It could be argued that the former are undisputed fourth order centers, while the latter are either retreating from that status or climbing to it; Heathfield might tentatively be suggested as a "climbing" center, and Battle as one which is being eclipsed by the nearby and growing seaside towns of Bexhill

[25] J. E. Brush: "The Hierarchy of Central Places in Southwestern Wisconsin," *Geogr. Rev.*, Vol. 43, 1953, pp. 380–402.

[26] J. E. Brush and H. E. Bracey: "Rural Service Centers in Southwestern Wisconsin and Southern England," *Geogr. Rev.*, Vol. 45, 1955, pp. 559–569.

and Hastings. Sven Godlund[27] has traced in southern Sweden how new centers have slowly appeared over the years in a region where gradually increasing population was the main changing feature in the economic landscape.

FIFTH, AND OTHER, ORDERS

It is now necessary to say something about centers of lower order than the fourth. There is in practice of course no simply recognizable hierarchy, and it is difficult to say how far one is justified in descending the scale.[28] Hans Carol[29] takes the classification down to individual farms and fields as the lowest orders of functional unit, but we must remember that some fields are in fact subdivided. In many regions, the *Service Village* is a clearly recognizable thing; its greatest development is perhaps to be seen in the "village-towns" of Hungary, where the services provided in settlements of 20,000 or more are not those which characterize a town. In other regions, as for example among the hamlets of Jutish Kent in England, or the dispersed settlements of Celtic Britain, the service village is not so clearly recognizable as elsewhere. Shops, like the farmhouses, inns, and even the parish churches often stand on their own. Yet, even where other factors locally eclipse it, there at least exists a tendency towards this order of centralization, and it would be not unfair to describe the service village as the *norm* of *fifth order* centers. The East Sussex survey[30] suggests that in at least one part of England no place begins to come into the category of service village unless it has a population of more than 250.

I have suggested elsewhere that a map showing fourth order centers and their hinterlands shows in general the sum of innumerable individuals' answers to the question: "Where do you most often go when you make a journey to a shop, inn, or other establishment, other than the nearest local one?" In the norm, the local one would be in the service village. One deviation from the norm would be what is found in many parts of Ireland, namely individual and isolated shops, with nucleated centers here and there which seem intermediate in type between the East Anglian service village and the typical fourth order center. Another type of deviation is where a region is too sparsely inhabited to be able to support fourth order centers with the usual range of services. This is where Smailes' map of England and Wales differs from the 1/625,000 Ordnance Survey Local Accessibility Map. His towns, in regions of dense habitation, are not always fourth order centers, and conversely the "local accessibility" centers, in regions of sparse habitation, are not always "towns," but are far enough apart to have recognizable fourth order hinterlands of their own, as in parts of the Highlands of Scotland.

[27] Sven Godlund: "Bustrafikens Framväxt och Funktion i de Urbana Influensfälten." Samhällvetenskapliga Studier 11, C. W. K. Gleerup, Lund, Sweden, 1954. (The main parts of this work have now appeared in English as: Lund Studies in Geography, Series B, Human Geography, No. 17, "Bus Service in Sweden," and No. 18 "The functional growth of bus traffic within the sphere of Urban Influence." Royal University of Lund, C. W. K. Gleerup, Publishers, Lund, 1956.)

[28] Brian J. L. Berry and William L. Garrison have recently, in a study of admittedly only 33 small places in one county in the state of Washington, produced good statistical evidence that there are real hierarchical divisions there corresponding to center populations of about 350 and 1000 population. See their "The Functional Bases of the Central Place Hierarchy," *Econ. Geogr.*, Vol. 34, 1958, pp. 145–154.

[29] Hans Carol: "Das Agrargeographische Betrachtungssystem," *Geographica Helvetica*, Vol. 1, 1952, pp. 17–67.

[30] F. H. W. Green: "Community of Interest Areas in Western Europe," *Econ. Geogr.*, Vol. 29, 1953, pp. 283–298.

CONCLUSION

This paper has been in the main a general discussion without conclusions. There are, however, some points which can usefully be made by way of summing up. The first of these is that we can in general agree with Lösch that there is a theoretical pattern of centers and hinterlands of different orders. This pattern, in spite of being very complicated, is recognizable to a surprising degree in practice, partly because certain orders in the hierarchy are more prominent than others. Secondly, we see what can be gained in the understanding of regionalism, the central core of geography, by directing our thinking along these lines. By speaking more about "functional" regions, we make regional geography more realistic to the man in the street, whose conception of such a region as the East Midlands of England corresponds much more to the second order hinterland of Nottingham than to the series of cuestas and intervening vales which characterize the "formal" region that roughly corresponds with it. To take another example, "Northeast Scotland" is the second order hinterland of Aberdeen; to define this area in terms of "formal" regions would be very much more complicated, for it is not a physical unity. A third point is that the community of interest area is more fundamental than its center, though in the modern world the strong forces of commerce make the growth of large and complex centers almost inevitable; and when they have developed they in turn greatly influence the hinterlands in which they were conceived. Through having come to be together within the second order hinterland of London, the man from Boston, Lincs., has in many respects more in common with a distant West-countryman from Yeovil, Somerset, than with someone from the neighboring county of Yorkshire. We await some regional geographies which bear the mark of all these considerations.

ACKNOWLEDGMENTS

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THE PAPALOAPAN PROJECT: AN EXPERIMENT IN TROPICAL DEVELOPMENT

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THE tropical lowlands of Latin America collectively constitute one of the world's last great frontiers. Traditionally avoided by highlanders and persons from extra-tropical regions, these lands have remained sparsely inhabited even though tremendous population pressures have built up in some of the nearby higher and cooler areas. They are characterized by low levels of living, limited participation in the national money economy, high rates of illiteracy, and a host of other features which identify them as "backward" or "underdeveloped" lands.

Interest in the development of underdeveloped lands in all parts of the world has been growing during the last few years. Not only have the great powers in world politics concerned themselves with the welfare of the countries once called backward; many of the underdeveloped nations themselves have undertaken development programs. Mexico is one such country. Most of her highland area has long since supported more than its optimum population; the natural increase, at a rate among the highest in the world, has been accommodated by the irrigation of new lands, more intensive use of previously cultivated land, migration to the rapidly growing large cities, and to a lesser extent by both permanent and seasonal migration to the United States. Inter-regional movements from the highlands to the coastal lowlands were practically non-existent prior to 1940. In the latter respect, Mexico is no different from most other Latin American countries.

During the administration of President Avila Camacho (1940–1946) it was officially recognized that the coastal lowlands of Mexico offer the greatest possibilities for increasing the production of food products and for accommodating some of the surplus population from the overpopulated Central Plateau. This led to the adoption of policies favoring the settlement and development of the tropical lowlands of both coasts. The occurrence of a disastrous flood along the plain of the Río Papaloapan in 1944 was the immediate stimulus for the establishment of the Papaloapan Commission, the agency which is carrying out the largest development program in Mexico. This program has been patterned after the TVA of the United States. Regionally, it affects the entire drainage basin of the Río Papaloapan, an area of some 46,000 square kilometers lying in the states of Veracruz, Oaxaca, and Puebla. This area is made up of parts of three major regions: (1) the coastal plain, (2) the Sierra Madre Oriental, and (3) the Plateau. The activities of the Commission have been concentrated in the coastal plain, but recently increasing

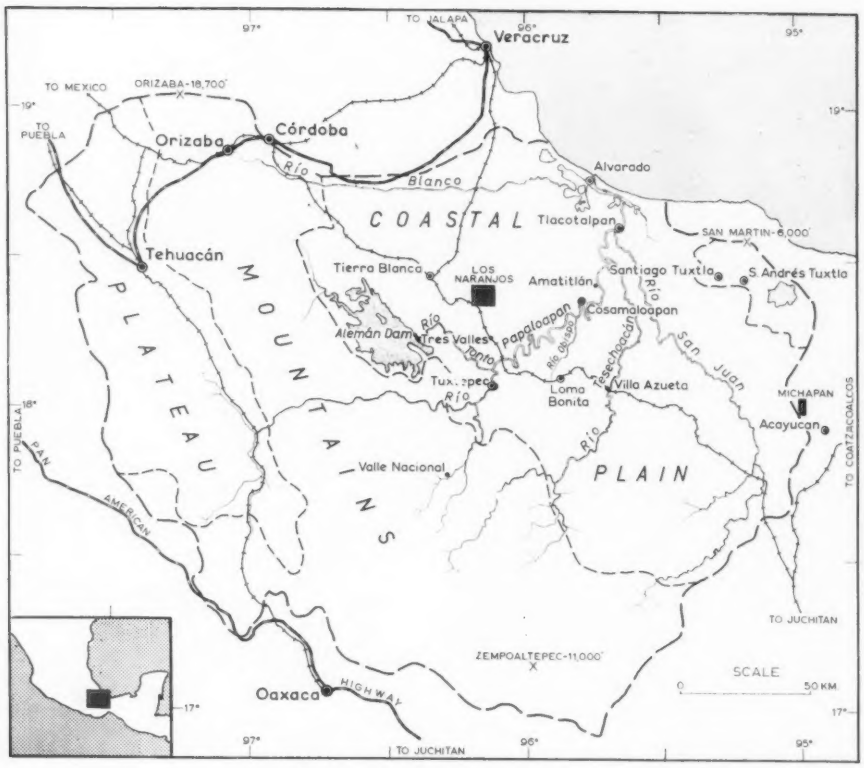


FIG. 1. The Papaloapan Basin.

attention has been devoted to the highland portions of the Basin. During the last three years, these areas have absorbed one-third of the budget of the Commission. Most of this money has gone for the construction of roads and schools and for agricultural development. These activities are regarded as necessary for the development of the lowlands as well as for the development of the highlands, for such problems as the silting of the major lowland streams are due principally to land use practices in the mountains.

The part of the Basin lying in the coastal plain proper, referred to here as the Lower Papaloapan Basin, is an area about twice the size of Puerto Rico, extending southward from the Córdoba-Veracruz highway to Acayucan. The climate is tropical with a pronounced dry season from December through May. Present vegetation ranges from treeless grassland to high forest. Probably most of the grassland and brushland has been culturally induced first by a system of fire agriculture and later to provide pasture for the cattle introduced by the Spaniards.

The remainder of this paper is devoted to a discussion of the lowland part of the Basin and the factors which have acted to retard development there, the measures which have been taken to overcome those obstacles, and other changes that are taking place at the

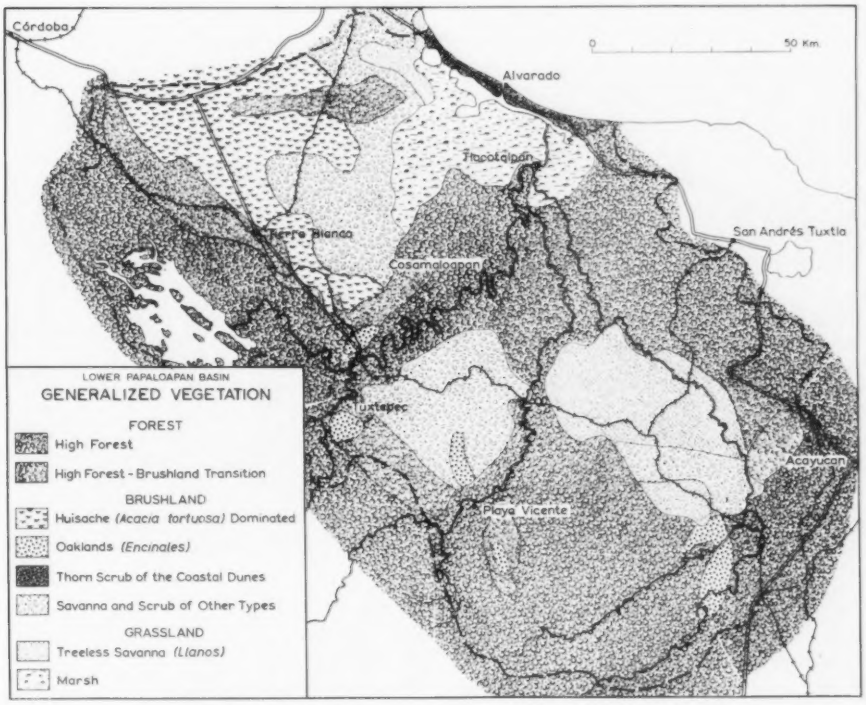


FIG. 2. Generalized vegetation, Lower Papaloapan Basin.

present time. In the closing paragraphs, an effort is made to indicate the extent to which the developments in the Lower Papaloapan Basin serve to suggest the potentialities and problems of other areas in the American tropics.

FACTORS RETARDING DEVELOPMENT

If it were possible to attribute the neglect of the tropical lowlands of Mexico (and of some other Latin American countries) to one single factor, that "cause" would not be the health problem, the climate, or any other aspect of the physical environment. It would be the fear and dislike of the tropical lowlands and their inhabitants which has existed among the people of the high Central Plateau for many decades.

To be sure, this fear and dislike is based to an important extent on features of the physical environment: the climate is uncomfortably hot for one accustomed to the cool highlands, and the forests and brushlands of the coast hold little appeal for people accustomed to the dry, unwooded regions of Spain or highland Mexico. Ignorance has also played its part in this respect. Nevertheless, some successful Spanish settlement took place in the Lower Papaloapan Basin early in the colonial period. By the end of the sixteenth century, the previously dense Indian population had been decimated by introduced diseases and by flight to nearby mountain fastnesses, and the coastal plain had been turned into one vast cattle range.[1] For most of the next

[1] Lesley Byrd Simpson: "Exploitation of Land in Central Mexico in the Sixteenth Century," *Ibero-Americano*, Berkeley and Los Angeles, Vol. 36, 1952, pp. 3–4.

350 years, however, changes were small and gradual. The hacienda system based on extensive cattle grazing reigned supreme except in a few especially favored areas where the commercial production of sugar cane was begun at an early date.[2] Settlement from other parts of Mexico or from abroad was virtually nil; the coastal plain was a region to be avoided at all costs unless one was forced to make a hurried trip to the port of Veracruz. What factors underlie the long-standing desire to avoid the tropical lowlands?

The Health Problem

The health problem has been severe in the Lower Papaloapan Basin since shortly after the Spanish conquest. The introduction of malaria, smallpox, and a number of less spectacular diseases all but wiped out the fairly large Indian population then living in the area.[3] Even today, half a century after the eradication of yellow fever, the poor health conditions of the Lower Papaloapan Basin are an important deterrent to settlement. Until recently, malaria has been so widespread that it is almost possible to say that everyone over ten years of age has or has had an attack.[4] Intestinal parasites are still all but universal. It is therefore small wonder that the people are easy prey for other diseases. Respiratory ailments, particularly tuberculosis, pneumonia, and influenza, are common.

The poor health conditions of the area are important in two respects. First, the high incidence of debilitating diseases is responsible for much suffering and acts to reduce the productive capacity of the people. Second, the high death rates in all age groups due to these and other preventable causes result in a large proportion of the efforts of the population being wasted in the production and care of children who do not live to reach their full productive capacity. The health problem, then, is truly a severe handicap to development, whether this is defined in terms of raising the levels of living of the local people or of producing larger amounts of goods for consumption outside the area.

Transportation

Just as poor health conditions have reduced the capacity of the people to produce, the lack of modern transportation facilities has limited the economic incentives to produce goods for sale in the outside world. The concentration of the zones of commercial agriculture along the banks of the major streams is due less to the better quality of the soils found there than to the fact that those streams were for centuries the only efficient transportation routes in the area.

Even though the facilities for transporting goods to and from outside points were greatly improved by the construction of railroads at the end of the last century and by more recent road building programs, the lack of modern transportation facilities is still a serious obstacle to development in most of the area. Except in narrow bands along the main routes, the movement of goods is difficult and time-consuming. Few motorable roads serve as feeder lines for the major streams, the railroads, and the new highways. Generally, products move to these routes by pack train, ox-cart, canoe, or human carrier.

"Marketing costs" are high for farmers who live away from the highways

[2] Fernando B. Sandoval: *La Historia de Azúcar en Nueva España*, Universidad Nacional Autónomo, México, 1952, pp. 24–30.

[3] Simpson, *op. cit.*, p. 26.

[4] The recent and tremendous reduction in the incidence of this disease is discussed in the section on the Papaloapan Commission as an agent of change.

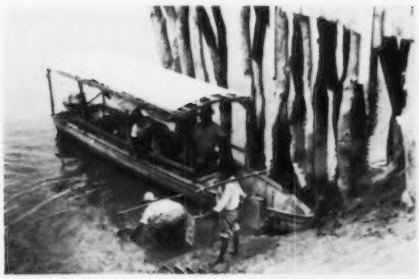


FIG. 3. Outside the larger centers, water for all purposes is taken from streams, springs, or wells which are often equally unsafe.

FIG. 4. Traffic jam on an unimproved road; truck and Land Rover (fender at left margin) are both stuck in mud.

FIG. 5. A commercial launch on Río Papaloapan.

FIG. 6. Launch and barge at Playa Vicente, loading goods for shipment downstream to nearest railroad.

FIG. 7. A ranchería, typical rural settlement form in the Lower Papaloapan Basin.

FIG. 8. A typical rural house.

and railroads. Perhaps this is due less to the actual costs of transportation than to monopolistic practices on the part of rural buyers. These merchants make small loans to the farmers during the growing season, requiring them to sell their marketable surplus at harvest time at a price well below the value of the crop.[5] Such practices are, of course, favored by the lack of modern transportation facilities in the minor trade centers.

[5] Moises T. de la Peña: *Veracruz Económico*, Gobierno del Estado de Veracruz, México, 1946, *passim.*; Fernando Cámara Barbechano: *Chacaltianguis: Comunidad Rural en la Ribera del Papaloapan*, Gobierno del Estado de Veracruz, México, 1952, p. 44; Alfonso Villa Rojas: *Los Mazatecos y el Problema Indígena de la Cuenca del Papaloapan*, Instituto Nacional Indigenista, México, 1955, pp. 129–130.

The lack of feeder roads is due to several factors. First, the area has been linked to the national highway system by all-weather roads for less than ten years. Before that, part of the advantage which might have been gained by local truck transportation would have been lost through the cost of transferring the goods from trucks to railroad cars or river launches. Second, the income of most people in the rural areas is much too small to permit them to buy any kind of motor vehicle; the few persons who do have the necessary means are usually the very ones who profit most by the lack of competition. Third, the construction of motorable roads is made difficult by dense vegetation and by the many small streams which cross the area. If such roads are to be passable at the end of the rainy season, when they are most needed, they must be of better quality than can now be built by the local people without outside aid. The lack of feeder roads is thus due to a combination of physical, economic, and cultural factors, some of which will continue to constitute obstacles to the construction of such roads for some time to come.

Population Factors

Several demographic factors have an unfavorable influence on the development of the Lower Papaloapan Basin. The generally low population density is in itself a handicap in some respects. Due to concentration of the population along the major streams, this handicap is even more pronounced in the least-developed parts of the area. The 1950 census reported a population of 308,000 for the entire area, or an average of 16 persons per square kilometer.[6] This population density is low when compared with that of the six most densely settled states of the Plateau (41 to 71 persons per square kilometer), which are generally too dry for unirrigated agriculture. It is little over half as high as that of the State of Veracruz (28) in which most of the area is located. When it is realized that the figure of 16 persons per square kilometer represents an average, and that the relatively dense populations along the Papaloapan, the Playa Vicente, and the lower Blanco rivers (about 40 persons per square kilometer) and around the base of the Tuxtlas mountains (30 persons per square kilometer) enter into that average, the significance of the figure becomes more apparent.

The population of the Lower Papaloapan Basin is overwhelmingly rural. Only 28 per cent of the people live in the 16 centers with 2500 or more inhabitants, the largest of which is Tierra Blanca with a population of 12,000. The dispersal of the population in small clusters of rural houses, together with the low density of population in most of the area, makes more difficult the work of reaching the people with health and educational programs. This work is further complicated along the base of the mountains and around Acayucan, where a large proportion of the population is made up of Indians who still speak their respective indigenous languages.[7] A rate of illiteracy which is high even for Mexico has a similar influence, requiring that most communication be carried out by the spoken rather than the written word.

The age composition of the population also acts to retard economic development. The productive capacity of the population is relatively low in terms

[6] By mid-1956 the population had probably passed 350,000.

[7] Mazatecs and Chinantecs along the base of the Sierra Madre Oriental, north and south of the Papaloapan respectively, and Popolucas around Acayucan. For a bibliography of studies on these groups, see Villa Rojas, *op. cit.*, pp. 159–165.

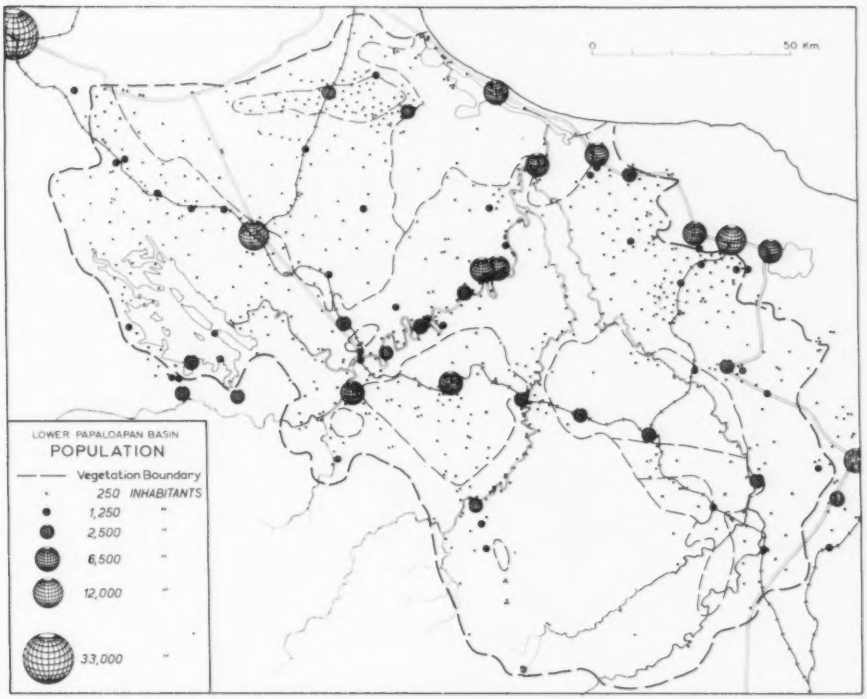


FIG. 9. Population distribution, Lower Papaloapan Basin, 1950. See Figure 2 for complete vegetation boundaries and types.

of its needs for food, clothing, and other goods, since from 35 to 50 per cent of the inhabitants of every *municipio* are under 15 years of age. Practically all of the people outside of the urban and "semi-urban" centers are engaged in agriculture, however, so this burden is not apparent to the people themselves, who welcome new children as future contributors to the welfare of the family.

In considering the potential capacity of the area to absorb migrants from the overpopulated parts of Mexico, the rapid rate of population growth by natural increase must be taken into account. The birth rate, near 50 per 1000 inhabitants, is among the highest in the world. Although the death rate (20 to 25 per 1000?) is also very high on a world-wide scale, it is nevertheless much lower than the birth rate. The rate of natural increase must now be somewhere between 2.5 and 3.0 per cent per year, a rate of growth which, if it continues, will double the population in from 23 to 28 years. There is little reason to expect a substantial decline in the birth rate in the near future, while the death rate will almost certainly fall as a result of the activities of the Papaloapan Commission.

Land Use

For most of the last four centuries the Lower Papaloapan Basin has been both a grazing and a crop farming area. This is not to say that it has been or is an area of mixed farming; far from it, the individual operator has traditionally been *either* a cattleman *or* a tiller of the

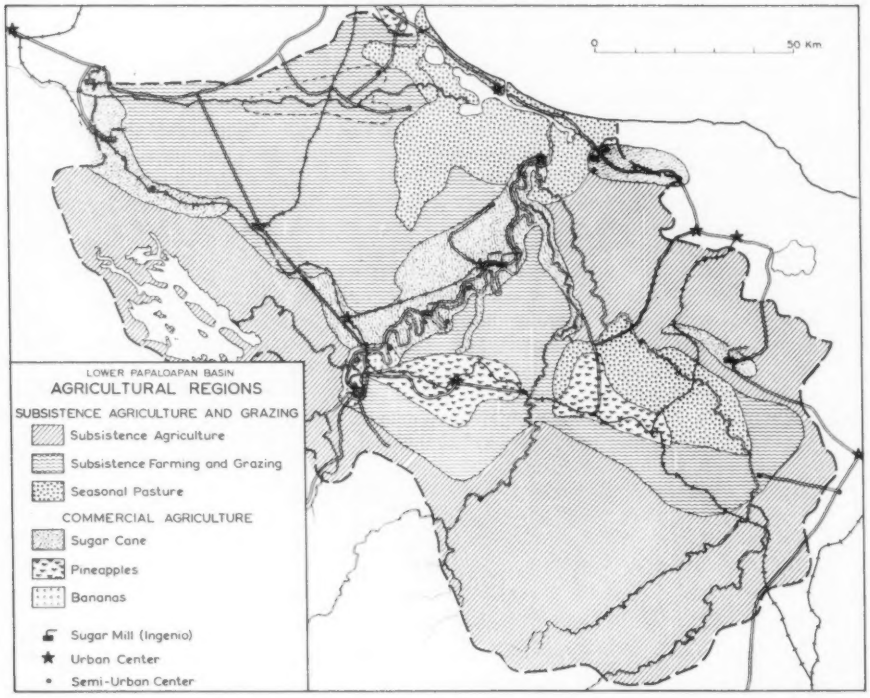


FIG. 10. Major agricultural regions, Lower Papaloapan Basin, about 1955.

soil. At an early date the two types of land use seem to have developed a relationship which, if not cooperative, at least was not one of open conflict such as that which prevailed for many years on the plains of the United States. Usually the specialization of farms has gone even farther than the basic division between crops and livestock. Ordinarily one was—and is—either a subsistence farmer specializing in the production of food for home consumption or a commercial farmer producing for market only one crop such as sugar cane or cotton, or more recently, sugar cane, bananas, pineapples, or rice.

The regional specialization of agriculture within the area is also great, although less pronounced than for individual farms. In the regions of subsistence farming and grazing (Fig. 10), two types of farms are intermingled in a sort of symbiosis. There, large private holdings, usually the remnants of old haciendas and often with at least a few square miles of land even today, are devoted to the production of cattle on an extensive basis. Landless laborers are allowed to grow their crops in fields of five acres or less on the lands of these estates, and, in return, are available for work for the owners at prevailing wages when they are needed. The landowner benefits from this system in two ways. First, a supply of labor is always available to him. Second, about five acres of brushland are cleared by the subsistence farmer every year or two, providing better pasture for the owner's cattle. Most of the members of *ejidos* (landholding agricultural communities created under

legislation arising from the Revolution of 1910–1917) are also subsistence farmers, and some of them work as laborers on the cattle estates in addition to growing their own crops of corn, beans, and rice. The seasonal pasture regions shown in Figure 10 might be included in the adjacent subsistence farming and grazing regions, but they are not considered suitable for the production of most crops.

The regions of commercial pineapple production are even more diversified than those devoted to subsistence farming and grazing from which they were formed. Pineapples are the principal product of these regions in terms of the value of goods leaving the area, but grazing and the production of subsistence crops are also of considerable importance. It is in these regions that agriculture most closely approaches general farming, and that the highest rural levels of living are to be observed.

Both the regions of subsistence agriculture and grazing, and the pineapple regions, are covered by a type of vegetation referred to here as brushland. This type of vegetation consists of a continuous grass cover dotted with bushes and low trees. The present use of lands of this type for corn, beans, and rice grown as subsistence crops, and for pineapples and rice grown as commercial crops, demonstrates that at least some of these soils are suitable for crop farming even though they have traditionally been used for extensive grazing.

The present banana region is a small remnant from an era when this part of Mexico was an important exporter of bananas. At that time, much of the adjacent sugar region was devoted to the production of Gros Michel bananas. The spread of banana diseases in the 1930's brought the decline of the area as a banana exporter; today, the small region which still specializes in the production of bananas looks toward the Central Plateau for its markets. Several important changes have taken place in that region since the decline of export production. Plant diseases made necessary a change to more resistant varieties of bananas which have no place in the world market. At the same time, banana production became less profitable, and there was a shift to other crops, such as sugar cane and corn, and to the intensive production of livestock on planted pasture. The agriculture of the banana region is now rather diversified on a regional scale, but specialization is still great on the individual farms.

The regional specialization of agriculture is greatest in the regions at each end of the subsistence-commercial continuum. In the region of subsistence agriculture, the vast bulk of the land is still in forest. Tiny patches of corn, beans, and rice are scattered about each settlement. There are few cattle and horses, but several pigs and chickens are kept by each family. Production is oriented almost entirely toward home consumption. The small marketable surplus produced by each family goes to provide cash for other necessities of life, such as cloth, clothing, and machetes.

The regional specialization of agriculture is even greater in the sugar producing regions. Along the banks of the Papaloapan from Tlacotalpan to Otatitlán, along the Obispo and the Tesechoacan for a considerable distance upstream from the Papaloapan, and on the major transportation routes in other sugar regions, one at first sight believes the people grow nothing but sugar cane. A closer examination reveals that here and there small patches of corn are grown in inferior locations. In Amatitlán, the only *municipio* that lies entirely within one of these regions of sugar monoculture, 94 per cent of the land

in crops reported in the 1950 census was in sugar cane.

Clearly, the problems of development differ greatly among these regions. In the region of subsistence agriculture, much of the arable land lies idle, covered with forest of little commercial value due to the mixed stands of trees, the small proportion of trees of marketable species, and high transportation costs.

In the regions of subsistence farming and grazing, a great deal of land that is suitable for the production of crops needed to feed the rapidly growing population of the Plateau supports only a few head of cattle per square kilometer.

In the regions of sugar monoculture, something near the maximum value of product is being squeezed from the land, but the levels of living of the tillers of the soil—and the cutters of the cane—are miserably low. Production of the basic food crop, corn, would apparently yield as high a monetary return as sugar, would reduce seasonal unemployment, and would make the local economy less sensitive to fluctuations in the market price of a single crop. Should any interruption occur in the present prosperity, the people of the regions of sugar monoculture would suffer tremendously. Seemingly a *better balance* could be achieved between the amount of land devoted to sugar and the amount used to produce basic food crops.

In the banana region as in the sugar regions, most of the land suitable for crops is already in use. The agriculture of the region has become fairly diversified as a result of the catastrophic decline of the banana export industry some 15 years ago. Although some problems of land use remain, they are small in comparison with those found in the other regions of the area.

In the pineapple regions, there is some room for the expansion of agriculture by diverting land from grazing to crop production. As in the banana region, land use problems as such are of relatively minor importance in terms of developmental activities.

Land Systems

For centuries after the Spanish conquest, most of the land of the Lower Papaloapan Basin was controlled by a few powerful owners. During the 23 years from 1580 through 1602, about one-half of the land in the Cantón of Cosamaloapan (total area 6100 square kilometers, 1950 population 82,000) was granted to 52 private individuals, three of whom together received rights to one-tenth of all the land in the Cantón.[8] Such grants were not restricted to the Cantón of Cosamaloapan; they were made in all parts of the Lower Papaloapan Basin.

In the seventeenth and eighteenth centuries, still more of the land passed into large estates. By the beginning of the Revolution in 1910, the concentration of land ownership in the hands of a small group of upper-class persons was nearly complete. Usually, prestige was a more important motive for land ownership than profit. Except for a few sugar producers along the plain of the Papaloapan itself, the owners were content with a relatively small return from cattle ranching and had little interest in devoting their land to more productive use.

The remainder of the people—certainly at least 80 per cent of the families—were without land of their own. Most of them gained their living through the *colono* system, under which they were permitted to grow small patches of sub-

[8] Octaviano Corro R.: *El Cantón de Cosamaloapan: Noticias de Geografía y de Historia*, n. p. Cosamaloapan, Veracruz, 1951, pp. 78–80.

sistence crops on the land of a large estate while working there, or at least being available to work, as laborers. These peons were forced to remain on the estates by a system of debt bondage; any effort on their part to grow crops for market would have been met with immediate resistance from the landlord, for the economic independence of the peon would have destroyed the labor supply of the large estate.

The provisions of the Constitution of 1917 for land reform are so well known that they need not be summarized here.[9] In the Lower Papaloapan Basin, little land was given to *ejidos* before 1935. During the next 15 years, approximately two-fifths of all the land in the part of the area lying in the State of Veracruz was granted to some 500 *ejidos*, with a total of 28,000 members in 1950.[10] Even at mid-century, however, much of the best land of the area remained in farms operated as large estates. In 1945, two-fifths of the land was in 146 large holdings, each with 2500 acres or more.[11] Many of the people engaged in agriculture still have no land of their own. About half of the families do have some land, either in *ejidos* or as private holdings, but many of the heads of those families work as farm laborers after caring for their own fields. Except in the region of sugar monoculture, and possibly in some parts of the area near the mountain front, the great majority of the families now have access to as much land as they wish to plant on their own account, either in their own ejidal or private holdings or through a greatly liberalized form of the *colono* system. When and if the people in general wish to expand their agricultural production, however, the concentration of land ownership will severely limit such expansion for perhaps half of the families engaged in farming.

Systems of Agriculture

If most of the families have access to as much land as they wish to plant, why is per capita agricultural production so low? One important reason lies in the labor-consuming agricultural techniques characteristic of the area.

The age-old system of fire agriculture, only slightly modified since the pre-Columbian era, is still all but universal outside of the areas of commercial agriculture and narrow belts along the major transportation routes in other regions. Under this system, a new field is cleared and burned every two years, at which time the previous field is abandoned. Except for the clearing operation, in which fire does most of the work, man's hand is not aided by any implement more effective than the machete. During the dry season, the trees and undergrowth are cut, left to dry, and later burned. With the first summer rains, the seeds are planted. Between planting and harvest, the field is "cleaned" two or three times; this process is limited to cutting the weeds with a machete. As soon as the grains of corn have reached their full size, the

[9] For a comprehensive discussion of the land reform program, see Nathan L. Whetten: *Rural Mexico*, University of Chicago Press, Chicago, 1948.

[10] *México, Tercer Censo Agrícola Ganadero y Ejidal*.

[11] De la Peña, *op. cit.*, Vol. I, pp. 133–134. Data from the 1950 census on size of holdings, received after this article was in proof, show no significant change in the amount of land in holdings of over 2500 acres in the Ex-Cantón of Cosamaloapan. Preliminary analysis of the census data for the entire Lower Papaloapan Basin indicates that this Ex-Cantón is representative of the entire area in this respect. Counting ejidatarios as farm operators, each with an ejidal holding of the average size of such holdings in the same municipio, one per cent of the farm operators controlled 47 per cent of the land in holdings; at the other end of the scale, 15 per cent of the farm operators controlled only 1.5 per cent of the land in holdings. Dirección General de Estadística: *Tercer Censo Agrícola-Ganadero y Ejidal*, volumes for Veracruz and Oaxaca, México, 1956, Tables 25 and 30.

stalk is doubled over just below the ear. A few weeks later the dried ears are collected and carried to the house.

The yields per acre under this system are not low, although they vary considerably not only from place to place and from year to year depending on weather conditions, but also with the age of the field. In good years, the first summer crop yields from one and one-half to three tons of corn per hectare; the succeeding winter crop yields from one to two tons. The average yield per man-day of labor may be "estimated" to be on the general order of 70 pounds of corn over the two-year life of a field.

Surprisingly enough, the system of plow farming used in the area does not yield much better returns per acre or per man-day. Its chief advantage is that it makes possible the permanent use of the same field, whereas at least four-fifths of the land must be "resting" at any given time under the system of fire agriculture.

The invasion of grasses is to a large extent reponsible for the low yields per man-day of labor under both systems, and seems to be the basic factor responsible for abandoning fields cultivated by fire agriculture.[12] Neither the machete nor the small plow used for the purpose is an efficient tool for removing grass from the growing corn field. By the same token, oxen are not the most efficient animals for use in cultivating between rows of growing crops due to their lumbering gait. Perhaps the introduction of some specialized type of cultivator, to be drawn by mules or horses, would be the most practical immediate solution, since few of the rural families can afford tractors. Until recently, however, there have been no mules in the area, and horses are still "status animals" used only for riding.[13]

The mechanization of agriculture is only beginning in the Lower Papaloapan Basin, unless one counts the change from wooden to steel plows in the areas where plows are used. Mechanization is most often thought of exclusively in terms of tractors and other expensive equipment. This places it beyond the economic reach of practically all the farmers of the area. The possible advantages of encouraging the use of less spectacular tools, operated entirely by hand or drawn by animals, is not being overlooked. The Papaloapan Commission has, in fact, met with some success in its efforts to introduce mules in the Los Naranjos and Michapan colonies, where it was found impractical to pass from the digging stick or the wooden plow to the tractor in a single step. The principal problem involved is acclimatization of the stock—mules have never before existed in the coastal plain of Veracruz.

Levels and Standards of Living

Life in the Lower Papaloapan Basin is near the creature level of existence except for the few members of the upper class, most of whom live in urban centers. Food, clothing, and shelter absorb the bulk of the income of the people; although no detailed studies have been made, it is the writer's impression that the typical (modal) family must devote at least four-fifths of its real income to providing these basic necessities of life. "Luxuries" include little more than cigarettes, matches, soft drinks, and alcoholic beverages.

The diet of the typical family is limited in variety if not in bulk. Corn, principally in the form of tortillas, is the basic food. It is supplemented by

[12] For some evidence in support of this hypothesis, see Wm. W. Winnie, Jr.: *The Lower Papaloapan Basin; Land and People*, University of Florida Ph.D. dissertation, June, 1956, Chapter IX.

[13] Except in the town of Cosamaloapan, where a few horse-drawn carts are in daily use.

beans and usually by rice at every meal. Vegetables, when available, are eaten at mid-day. Eggs enter into the diet two or three times a week, but meat and poultry are reserved for special occasions. Families living near the major streams use fish caught by trap, net, or hook to a varying extent. Throughout the year, bananas are fairly common in the diet, most families having several plants around their houses. Most other fruits produced in the area ripen only during brief seasons, when great quantities of them are eaten and used to make punch. In brief, the diet is simple and tends to be monotonous. To judge from the appearance of the people, however, it is generally adequate in both quality and quantity.

The warm climate makes unnecessary the construction of elaborate houses. The typical house of the region has a dirt floor and a thatch roof. Wall materials vary from place to place, but, basically, the wall consists of vertical boards or sticks. In the Popoluca area (around Acayucan) it is customary to plaster the stick wall with mud, thereby forming a wattle-and-daub type of structure. Usually there are no more than two or three rooms in the house, even though families are very large. Such houses provide adequate shelter from the elements, but the dirt floor leaves something to be desired from the point of view of health, and there is little privacy. Important as it may be in other cultures, however, the last consideration has little meaning here.

Clothing needs are also limited. Since there are few uncomfortably cool days in the year, clothing serves more as a badge of status than as protection against the elements. Only the rubberized "poncho" (in Boy Scout rather than local terminology) and the hat are primarily protective garments, the first against the rain and the second against both rain and sun. Except in the Chinantec area (along the base of the mountains south of the Papaloapan), factory-made, European-style clothes are the rule. Generally the men wear simple work clothes and the women, cheap print house dresses. Many people habitually go barefooted, even though they may have a pair of shoes for use on special occasions.[14] Those who habitually wear shoes use either cheap oxfords or high work shoes, often with soles made from worn-out tires, or the more "typical" *botín* or *zapato vaquero*, an ankle-high, low-heeled boot somewhat like our "cowboy" boot.

Altogether, most of the basic necessities of life are supplied in the community without recourse to a money economy. The work involved is done either by the nuclear family or collectively through a mutual aid system. Not many decades ago, even clothing was made within the community from cotton grown in the region. Now, however, the production of cotton has all but disappeared, and most people buy cheap, ready-made clothing produced in the mills of Puebla and other large Mexican cities. The individual family pays for these "imports" either by the sale of surplus subsistence crops or hogs, or with cash income earned by male members who work from time to time as day laborers on commercial farms.

Though we may consider the level of living of the peasant abysmally low, it is well to bear in mind that it is much higher now, especially in nonmaterial aspects, than it was 40 years ago. Generally, the people are contented with their lot in life, and have few unsatisfied desires. The present low levels of living are themselves ob-

[14] The census figures on the population habitually wearing shoes are probably more indicative of the number of persons who *own* shoes than of the number who wear them every day.

stacles to development at the same time that they are objects of development. Regardless of the desires of the people, their infinitesimal cash incomes severely restrict the expenditures which they might be induced to make to improve their way of life.

THE PAPALOAPAN COMMISSION AS AN AGENT OF CHANGE[15]

The objectives of the Papaloapan Commission are defined in broad and not wholly materialistic terms. In brief, that agency is to strive to raise levels of living and reduce human suffering in the area, at the same time that it brings about an increase in the production of goods in general and food in particular. It is allowed considerable choice in the exact means it selects to achieve these goals. Its most important developmental activities during the first decade of its existence have included a health program, the improvement of transportation facilities, colonization, agricultural experimentation, and flood control. A resource inventory, delayed until now by the lack of adequate maps, has recently been started. Each of these activities is discussed separately in this section.

Research[16]

The almost complete lack of knowledge regarding the topography, hydrography, climate, soils, and human resources of the area has been a major handicap in planning and carrying out the work of the Papaloapan Commission. Accordingly, a large part of the efforts of the Commission has been devoted to research on these subjects. The knowledge gained in this manner is making it possible to plan the remaining activities of the Commission with less danger of error and at lower cost. It should be emphasized that this research is still going on. Large-scale (1:50,000) maps of the area, based on aerial photographs made in 1947, have just been completed. Field work for a generalized soils map for the entire area began only last year and will not be finished for a year or more. One of the most important lessons which the Papaloapan project can give to any development program in the American tropics is that a large proportion of the early part of the program must be given over to research on the natural resources and the people of the region to be developed. The director (*Vocal Ejecutivo*) of the Papaloapan Commission believes, on the basis of his experience, that "any effort to develop new tropical lands in Mexico or any other Latin American country must be begun with work of this sort, even though other obviously useful projects may be undertaken at the same time . . . ."[17]

The Health Program

The work of the Papaloapan Commission to improve health conditions has followed three separate lines of attack. First, the spraying of houses with residual DDT has brought tremendous declines in the incidence of malaria in the treated communities. The Commission's Bureau of Sanitary Services estimated in mid-1956 that 80 per cent of the houses in the lowland part of the area had been treated at least once by that time, 19,000 of them recently enough so that the DDT was still fully effective. The Lower Papaloapan Basin is thus somewhat ahead of the Mexican tropics in general, where a nation-wide

[15] The author is greatly indebted to Ingeniero Raúl Sandoval Landázuri and other officials of the Comisión del Papaloapan for the information they have supplied and the suggestions they have offered for the improvement of this and other sections of the paper.

[16] Agricultural experimentation is discussed separately in a later section of the paper.

[17] Letter, Sandoval to Winnie, September 18, 1956. (Translation from Spanish by the author.)

program is expected to eliminate malaria within about five years. The success of the program in the Basin is indicated by the results of a sample survey of 62 localities, which show that the incidence of malaria has been reduced from 14 per thousand in 1948 to 2 per thousand in 1955. Within a few years, malaria will have been as completely eradicated from the Lower Papaloapan Basin as it has been from the Southern United States.

Second, the Commission has built eight sewage systems and provided safe drinking water supplies in 39 towns with a total of 108,000 inhabitants. This is probably the most effective attack on intestinal parasites that is practical at this time, but it has little effect on the 80 per cent of the population living outside of the centers involved. This work is always done on a co-operative basis, the towns meeting at least one-half of the cost of their projects.

Third, the Commission has made medical services available to at least part of the people through the operation of medical offices in five centers. Each of these offices is staffed by one doctor, one nurse, and one medical administrator, in addition to two non-professional assistants. Similar offices have been operated in 19 other centers since 1947. The services of these medical offices are completely gratuitous, and are available to all of the inhabitants in their respective areas. The Commission has also arranged for new graduates in medicine to perform their six-month period of obligatory "social service" working for it in rural communities in the area. In mid-1956, twelve of these doctors were working in as many different rural communities.

Altogether, this program has made considerable progress. The incidence of malaria already has been greatly reduced. Most of the way is still left to go in reducing the incidence of intestinal parasites to a reasonable level. So far, the Commission has demonstrated that good health conditions can be achieved in both large and small communities. The lack of reliable statistics precludes the measurement of the improvements made in the area as a whole and the determination of the cost of the improvements on any sort of a relative basis.

Transportation

One of the most spectacular and at the same time most beneficial activities of the Commission has been its road building program. A first-class highway has been built from the Córdoba-Veracruz highway to Tlacotalpan, and excellent all-weather roads extend this basic route to Alemán Dam and Valle Nacional, both near the base of the mountains, and to Villa Azueta on the Río Tesechoacan. Additional graded roads now nearing completion, together with peripheral highways built by other agencies, will provide a nearly complete network of arterial highways within the area. Up to this writing, the Papaloapan Commission has built a total of 168 kilometers of paved trunk highways, 369 kilometers of graded secondary highways, and 262 kilometers of feeder roads. The greatest remaining gap in the road network is in the large, virtually uninhabited high forest region south of the Río Playa Vicente. Future work will be concentrated on the provision of feeder roads to connect minor trade centers to the main highways.

Education

Closely coupled with the road building program, the provision of schools has been a major activity for the promotion of social and economic change. Together, the "road-school" combina-

tion has proved "indispensable in promoting the social and economic improvement of backward groups on a firm basis."[18] In this regard, it is well to bear in mind that the two basic functions of an educational system are (1) to develop new desires and (2) to provide the skills necessary to fulfil those desires. Up to the present time the Commission has built 87 schools in the lowland portion of the Basin. The largest of them has eight classrooms—most have only one or two, and all 87 together have a total of 186. These schools serve a school-age population of 8700, or about one-tenth of the total population of school age. Other schools already in existence serve some of the remaining communities, but even so there is still considerable room for improvement. Once a school building has been constructed by the Commission, it is usually turned over to the state or national educational authorities for operation.

Colonization

During the last three years, the Papaloapan Commission has founded two major colonies (Los Naranjos and Michapan) and several minor ones. The latter serve primarily to accommodate the Indians displaced by the construction of Alemán Dam, but the former also have been peopled with families from outside the Basin. To date, 2700 families from the basin of Alemán Dam have been resettled in these colonies, and 539 families from outside the area have been established in Los Naranjos and Michapan.

Although the exact manner of granting land and providing credit for both equipment and crop loans varies considerably between the two major colonies, the basic policies are the same in both cases. The colonizing families purchase cleared tracts of land of ten hectares per working man on long term credit. At the same time that the plots are too small to encourage the development of anything larger than family-size farms on which the owner himself performs a substantial share of the labor, future population growth is taken into account by holding substantial reserves of land for sale to the children of the original colonists. Simple but hygienic and attractive houses are built for the colonists before they arrive. Credit is provided for crop loans and for the purchase of modern farming equipment, as well as for purchasing the land. In the early years, the colonists are watched closely by agricultural and other experts employed by the Commission, and their operations are closely supervised in cases where such supervision is required to insure their success.

Colonization should not be regarded as a process which will bring about the peopling of the entire area due to its high cost (about 2000 dollars per family for the first year, when the salaries of the Commission's Bureau of Colonization are taken into account). It probably acts as a leavening agent in encouraging spontaneous settlement, however, and certainly serves an important end by establishing farms which test further the practices developed in the experiment stations and which demonstrate to the people already in the area the advantages of using improved seeds and modern agricultural techniques.

Agricultural Experimentation

The Papaloapan Commission operates three agricultural experiment stations. This phase of the development program is directed toward the diversification of

[18] Letter, Sandoval to Winnie, September 18, 1956. (Translation from Spanish by the author.)

FIG. 11. One of many new roads built by the Commission. (Courtesy of the Papaloapan Commission.)

FIG. 12. Temporary bridge under construction over Río San Juan; most large streams are crossed by ferry, smaller ones by bridge.

FIG. 13. A landing strip built by the Commission at one of the most isolated communities in the Lower Papaloapan Basin. (Courtesy of the Papaloapan Commission.)

FIG. 14. A rural school built by the Commission in cooperation with the community in which it is located. (Courtesy of the Papaloapan Commission.)

FIG. 15. Large-scale test of selected rice seed, Los Naranjos colony. (Courtesy of the Papaloapan Commission.)

FIG. 16. Alemán Dam at high water in 1954. (Courtesy of the Papaloapan Commission.)

agriculture and an increase in yields through the development of improved strains of the principal crops now grown in the area, the introduction of new commercial crops, and research on agricultural techniques and soil conservation and improvement. Its greatest contributions so far lie in the development of strains of corn and rice especially for use in the area. Too little time has elapsed since the development of these new varieties to permit the production of large quantities of seed, so their use is still limited to the colonies and a few independent commercial farms.

Flood Control and Irrigation

The Papaloapan Commission, closely associated with the Ministry of Water Resources, has been greatly concerned with water resource problems ever since it was established in 1947. Early in the program, it intended to irrigate extensive areas in the lowlands. Later, as more knowledge of conditions in the area accumulated, it was decided that other types of work would be of greater immediate benefit, and irrigation projects came to be of secondary importance. Flood control, however, has remained one of the principal activities of the Commission. Of the flood control projects, Alemán Dam has been the most important. The largest dam in Mexico, this 22 million dollar structure greatly reduces the risk of floods along the Lower Papaloapan by holding back the flood waters of the Tonto, one of the principal tributaries. Ultimately, the dam will produce 184,000 kilowatts of electricity for use in the states of Puebla, Veracruz, and Oaxaca. The availability of cheap hydroelectric power will make possible a considerable increase in industrialization, now largely restricted to the first stages of processing agricultural products of the area itself.

The other flood control work has also been concentrated on the Papaloapan Valley proper. Seven cuts have been made through meanders in the course of the main stream, and the channel has been dredged in places. Both of these projects reduce the danger of floods by increasing the rate at which flood waters run out into the Gulf. A considerable part of the flood plain has also been protected by the construction of artificial levees that at the same time are used as roads.

Although it will take many years for these improvements to "pay for themselves," several potentially serious floods have already been either prevented or restricted to small areas where damage was relatively slight.

Other Activities

The work of the Papaloapan Commission has included many activities in addition to the ones discussed above. Taken together, these activities constitute an integrated program for the development of the area. Generally speaking, this program is designed to make all of the inhabitants active participants in the national economy and culture, to make the area a healthier and otherwise more pleasant place to live, and to encourage settlement of its sparsely inhabited parts.

OTHER TRENDS

The Lower Papaloapan Basin is undergoing a period of rapid social and economic change. Some of the trends now taking place are directly related to the activities of the Papaloapan Commission, and have therefore been discussed in the preceding section of this paper. Any survey of conditions in the area today would be incomplete if it failed to mention four other trends which were either already under way when the Commission was established or which have begun since that time but are only indirectly related to its activities.

The beginning of the growth of a rural middle class in many parts of Mexico is probably the most important trend closely associated with the Revolution; it will most likely be regarded as the most important development of the century by future historians of Mexico.[19] Of the host of factors which lie

[19] For an excellent discussion of Latin American value systems and class structure in relation to development, see T. Lynn Smith: "Values Held by People in Latin America which Affect Technical Cooperation," *Rural Sociology*, Vol. 21, 1956, pp. 68–75.

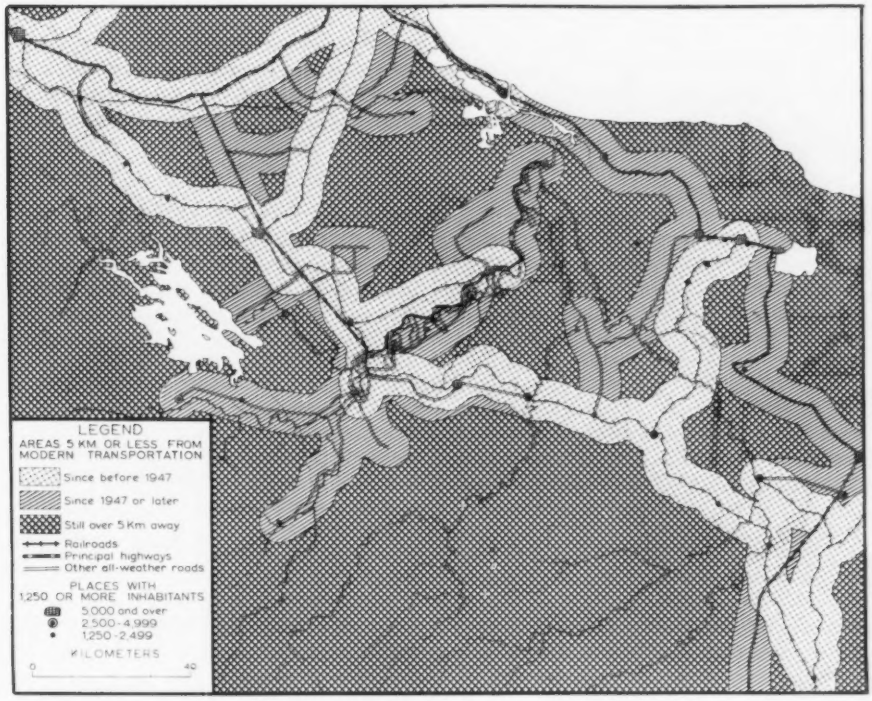


FIG. 17. Areas five kilometers or less from modern land transportation routes, Lower Papaloapan Basin and adjacent areas, late 1955.

behind the appearance of a nascent rural middle class in the Lower Papaloapan Basin, one seems to exceed all others in importance. The redistribution of land made available to the peasants the resources needed to improve their lot in life. At the same time, it made it necessary for them to perform the management function to at least a limited extent if they were to survive, but it did so without removing the necessity that they continue to perform the labor function, now in their own fields. Thus the functions of management and labor were combined in one individual, at the same time that he was given "capital" in the form of land. This combination of the economic functions is a characteristic of the middle class of the United States, and may well be a necessary (but not necessarily sufficient) cause for the development of a rural middle class anywhere. Many aspects of the appearance of a rural middle class in the two-class society of the Lower Papaloapan Basin exert a highly favorable influence on development. Among the most important of them are the increasing skills of the people and the growth of a desire for a higher level of living.

The second of the four trends discussed in this section is the commercialization of agriculture. This trend is so closely related to the first that the two may be separated only in an abstract discussion. The agriculture of the area is being commercialized in two ways. First, many former subsistence farmers are producing ever larger sur-

pluses for sale. Usually this represents an increase in their total production, for in most cases larger amounts of land are planted in the crop intended partly for sale without appreciable reduction in the production of the other subsistence crops. The second manner in which commercialization is taking place is through the establishment of new commercial farms. Generally such farms are highly specialized in the production of a single market crop, and in many cases they are operated primarily with hired labor. The most important farms of this type founded in recent years are the highly mechanized rice plantations which have been established along the new highway north of Tres Valles.

The third trend, closely related to the first two, is the improvement of the systems of agriculture. Some of the commercial farms in the area have already been mechanized, and increasing numbers of subsistence and "semi-commercial" farmers are adopting the ox-drawn steel plow. Reliance on the unaided hand of man is decreasing as the use of non-human power increases. The recent introduction of mules, together with the earlier introduction of the steel plow, could in time revolutionize agricultural technology on the small farms of the area. As a result of the changes which have already occurred, per capita production probably is rising. Also, and possibly more important in the long run, the change from shifting to permanent cultivation greatly reduces the amount of land required to support each family.

Finally, spontaneous settlement is now taking place in the area. Migration from the highlands to the Lower Papaloapan Basin is not yet large, but it has at least begun. Some of the settlers are land hungry Indian or mestizo peasants from the near-by highlands of Oaxaca; they have established small, "semi-commercial" farms cultivated by plow farming or fire agriculture. Others are persons of some means—members of the middle class recruited from above instead of from below—who have purchased land in tracts usually of 250 acres or more from the remnants of the old cattle haciendas for the purpose of establishing highly specialized and usually highly mechananized commercial farms. Settlement of both types has taken place principally if not exclusively along the new roads.

THE PAPALOAPAN PROJECT IN RELATION TO THE DEVELOPMENT OF OTHER TROPICAL AREAS

It now appears very likely that the long-range program of the Papaloapan Commission will be highly successful in raising the levels of living of the inhabitants of the Lower Papaloapan Basin and will greatly increase the contribution of that area to the market economy of Mexico. Probably it will also stimulate the settlement of sparsely inhabited parts of the area. To what extend could similar programs expect equally successful results in other parts of the American tropics?

First, it must be realized that the chances of success of the Papaloapan project were greatly improved by the fact that some circumstances favorable for development had already been created in the area. Specifically, the land reform program, even though it still had "half the way left to go"[20] when the Commission was established, had laid the foundation for the development of a rural middle class. Even though a large proportion of the land is still controlled by relatively few persons, a large proportion of the *population* has enough

[20] De la Peña, *op. cit.*, Vol. I, p. 181.

land in family-size farms (principally in *ejidos*) for each family to produce a substantial surplus for market if it wishes to do so. One unanswerable question is: would as much development have taken place anyway within a decade or so, even if the Papaloapan project had never been put into operation?

Second, it must be recognized that "the tropics" are by no means that homogeneous expanse of rainforest inhabited by primitive gatherers or agriculturists that they are sometimes thought to be. To what extent are the physical and cultural characteristics of the Lower Papaloapan Basin like those of other parts of the tropical lowlands of Latin America? As far as such physical factors as climate, soils, and vegetation are concerned, conditions in the Basin cover a wide range. Although it does not begin to include all of the types of tropical physical environment found in Latin America, this variety suggests that many other parts of tropical America are also *physically* capable of being developed. The purely geographical factor of location is another matter, however. Few areas the size of the Lower Papaloapan Basin are bounded on one side by what has been one of the most important highways in Latin America since the dawn of the colonial period. Many parts of the American tropics lie so far from the nearest existing motorable road or railroad that they could not economically be connected to the national transportation system at this time.

The population factors which have acted to retard development in the Lower Papaloapan Basin are common throughout the American tropics. Health conditions are probably not much better anywhere in the tropical lowlands of Latin America than they were in the Lower Papaloapan Basin in 1947. The "Iberian curse"[21] of a two-class society, with most of the land controlled by a few members of the upper class, is characteristic of almost all of the tropical lowlands of Latin America. Due to the effects of the Revolution, the concentration of land ownership is probably less pronounced in the *tierra caliente* of Mexico than in that of any other Latin American nation. By the same token, few if any of the other countries now have legal machinery comparable to Mexico's for making land available in family-size plots to landless farmers. For the time being, at least, the land systems will do more to discourage development in the tropical lowlands of the other American nations than in those of Mexico.

The specialization of agriculture is probably at least as great in most other parts of the American tropics as in the Lower Papaloapan Basin. At the same time, except in areas now used for the production of tropical specialty crops such as bananas or sugar cane, participation in the national money economy is probably less in most of the other countries than in Mexico. On the other hand, it is probable that a greater part of the land is already in use in the Basin than in most other areas of comparable size in the American tropics.

On the whole, then, most of the deterrents to development in the Lower Papaloapan Basin seem to be present in most other parts of the tropical lowlands of Latin America. The appearance of a rural middle class, an important factor behind the present period of development in the Lower Papaloapan Basin, seems to be lacking in most other Latin American countries and even in some other parts of Mexico. Generally, conditions would seem to be less favorable for development else-

[21] Robert L. Pendleton: "The Place of Tropical Soils in Feeding the World," *Ceiba*, Vol. 4, 1954, pp. 201–222.

where in the American tropics than they were in the Lower Papaloapan Basin in 1947.

Nevertheless, active settlement is now going on in many places in the tropical lowlands of Latin America. In Mexico and Central America, highlanders are settling in the lowlands of both coasts. From Venezuela to Bolivia, settlers have pushed down into the lowlands east of the Andes, and in Ecuador a migration down the Pacific slope is under way. Brazil has made several unsuccessful attempts at colonization in Amazonia, but is expanding into formerly sparsely settled tropical areas in western São Paulo and the Rio Doce area of Minas Geraes. This highland-to-lowland migration represents the beginning of the development of one of the world's last great frontiers. In areas where conditions are already favorable for this development—areas such as the Llanos-Andes border in Venezuela[22]—carefully planned and executed development programs should have good chances for success. In areas where conditions are not yet favorable—virtually uninhabited areas like Amazonia, which lie at great distances from modern land transportation facilities, and which are also far removed from the densely settled regions of the hemisphere—programs patterned after the Papaloapan project would be likely to fail.

[22] Raymond E. Crist: "Along the Llanos-Andes Border in Venezuela: Then and Now," *Geogr. Rev.*, Vol. 46, 1956, pp. 187–208.

ACKNOWLEDGMENTS

The author wishes to express his deep gratitude for the co-operation he has received from the late Ingeniero Raúl Sandoval Landázuri, Vocal Ejecutivo (Executive Director) of the Papaloapan Commission during the last four years. Without the facilities which Ing. Sandoval made available to me, it would have been impossible to complete the field work for my doctoral dissertation (*The Lower Papaloapan Basin: Land and People*, University of Florida, June, 1956) on which this paper is based in part. Many stimulating discussions with Ing. Sandoval, who knew the Papaloapan Basin and its people better than anyone else, made a tremendous contribution to my own knowledge of the area. The many comments he made on an early draft of this paper have been incorporated in their entirety, and have greatly improved the quality of the study. Ing. Sandoval's untimely death in an aircraft accident in the Papaloapan Basin on November 13, 1956, was a serious loss for the Papaloapan Commission and for Mexico.

THE BRAUNSCHWEIG INDUSTRIAL AREA*

Robert E. Dickinson

Dr. Dickinson, Professor of Geography at Syracuse University, carried on the field work for this article during the summer of 1955.

SPECIAL problems of physical planning are presented by the rapid growth of industry during and since the war in the Braunschweig area of Germany. Situated midway between the Ruhr and Berlin, and midway between Hanover and Magdeburg, this area is crossed by three main west-east routes—rail, canal, and autobahn. Though central in the prewar Reich, it now lies in an eccentric position, adjacent to the boundary of the Russian Zone of occupation—the Iron Curtain. Thus, its markets must be oriented exclusively to the west. The zonal frontier cuts right through the prewar fabric of communications. The great influx of refugees across this frontier has also added enormously to the problems of postwar rehabilitation and employment. Like other areas adjacent to the zonal frontier, this one suffered from extreme unemployment down to 1950. Today this has virtually disappeared, but problems associated with abnormally rapid industrial growth still remain.

*This article is based on field work carried out in the summer of 1955. Thanks are due in particular to Dr. Rudolf Hoffmann of Braunschweig and to Professor Hans Poser of Hanover. Figures 1, 2, 3, 4, 7, and 8 are adapted from maps appearing in Dr. Hoffmann's report on "Die Notwendigkeit des Ausbaues der Verkehrswege und Verkehrsanlagen im Niedersächsischen Verwaltungsbezirk Braunschweig," *Denkschrift des Präsidenten des Niedersächsischen Verwaltungsbezirks Braunschweig*, 1954. Figures 5 and 6 are based on materials provided by Hüttenwerk Salzgitter and the Volkswagen concern. See also Dr. Hoffmann's "Verkehrsprobleme und Verkehrsplanung in Südostniedersachsen," *Internazionales Archiv für Verkehrswesen*, 1952, No. 24, and "Watenstedt-Salzgitter," *Raumforschung und Raumordnung*, 1950, pp. 105–110; and Herbert Michaelis' "Salzgitter: Raum- und Wirtschaftspolitische Probleme" in *Raumforschung und Raumordnung*, 1957, pp. 29–38.

The Setting

The area with which we are concerned is shown with respect to its political divisions in Figure 1. It corresponds with the main portion of the historic State (dukedom) of Braunschweig (or, in English, Brunswick). This straggled along the northern border of the Central Uplands from the Weser to the Aller Rivers, with its core in the Harz Foreland. It was embedded in the south of the Prussian Province (the old kingdom) of Hanover which in the territorial reorganization since the war has become the new State of Niedersachsen (Lower Saxony). The latter has incorporated the State of Braunschweig, that now becomes one of its major administrative divisions. In 1945 the new boundary between the zones of military occupation, now perpetuated as the boundary between the west and east German republics, generally followed the eastern border of the new State of Lower Saxony, except that most of the *Landkreis* of Blankenburg and the outlier of Calvorde (to the northeast, not shown on the map), formerly part of Braunschweig, now lie in the Soviet Zone. What remains in Lower Saxony now forms the *Verwaltungsbezirk* of Braunschweig. (There is still a small outlier at Thedinghausen near Bremen.)

Until recent decades this area re-

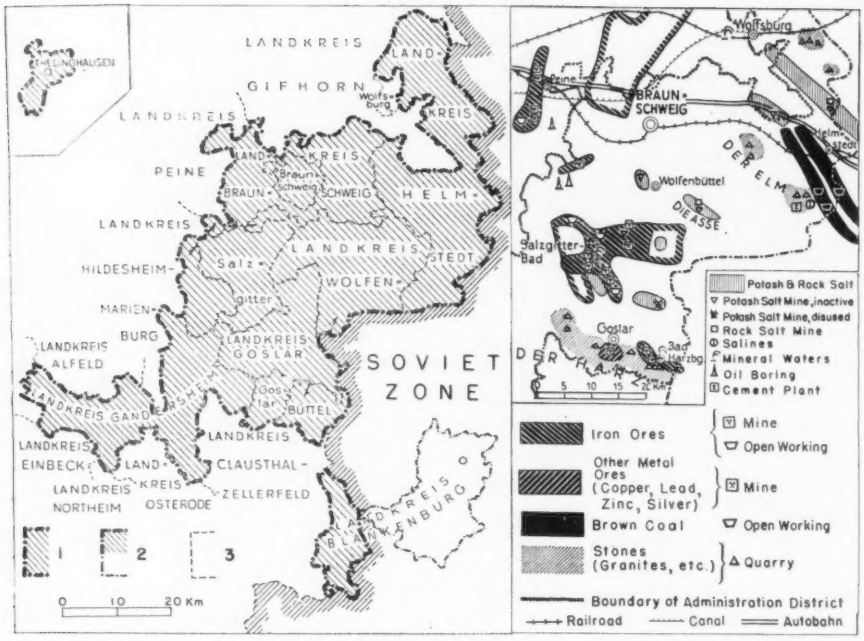


FIG. 1 (left). Political divisions: 1. *Verwaltungsbezirk* of Braunschweig in the state of Niedersachsen; 2. former state of Braunschweig; 3. town and rural districts (*Stadtkreise*, *Landkreise*). (*From Hoffmann.*)

FIG. 2 (right). Natural resources. The three major west-east routes are shown in the north of the area. Lebenstedt and Watenstedt, the chief seats of residence and industry respectively in the Salzgitter *gemeinde*, lie west of Wolfenbüttel and north of Salzgitter Bad. (*From Hoffmann.*)

mained predominantly agricultural with a relatively slow rate of economic growth. Braunschweig (239,000) is its political and economic capital, and far exceeds its nearest neighbors—Helmstedt (40,000), with brown coal mining, 40 kilometers to the east; Peine (28,000), with a late 19th century iron and steel industry, 25 kilometers to the west[1]; and the ancient capital and mining center of Goslar (35,000), at the foot of the Harz, 40 kilometers to the south. Since the thirties, however, the area has been exposed—during abnormal periods of economic depression, war and its aftermath—to the impact of two entirely new sets of conditions that have greatly increased its potential of economic growth. The first of these was the construction of the autobahn and the Mittelland canal, both running in the same west-east axis, a few miles north of Hanover, Braunschweig, and Magdeburg. The second was the beginning in 1937 of the large-scale exploitation of the underlying iron beds south of Braunschweig, that are now proven to be the largest in Germany,

[1] Peine is situated at the junction of the fertile loess land and the poorer northern lowland and lies near to rail, road, and canal. Iron ores began to be mined at Ilsede, 6 kilometers south of Peine, in the 1850's, and the furnaces established there draw their fuel direct from the Ruhr, formerly by rail and now by canal. The ores are a northerly continuation of the Salzgitter beds, but differ from the latter in that they are basic. The furnaces today produce about 650,000 tons of pig iron and employ 2000 workers. The steel works were established at Peine itself in the 1870's and employ about 3000 workers. Ore production from its own five mines reached 2 million tons in 1956.

exceeded in Europe only by the ore fields of Lorraine and Sweden.

The first vigorous expressions of this new potential are the iron and steel industry at Salzgitter, the mammoth Volkswagen automobile plant at Wolfsburg, and the accelerated growth of the city of Braunschweig. Both new centers lie within the economic orbit of Braunschweig, which is only 20 to 25 kilometers distant, so that all three urban areas and their surroundings have common problems of regional development and physical planning.

The main routes and natural resources of the area are shown in Figure 2. The routeways lie along an axial west-east belt at the junction of the heath and bog and patches of cultivated land of the Northern Lowland, and the fertile, closely settled loess plains of the Harz Foreland. The foreland has a base of Mesozoic strata that form several anticlinal ridges (mainly built of Triassic sandstones) with a north-west and south-east direction. These ridges are generally wooded, but the lowland between them is blanketed with loess and is rich, open, arable land with compact agricultural villages. Such country stretches to the foot of the Harz. Of special significance is the NNW-SSE Salzgitter ridge, that lies between the Innerste and Oker Valleys, in the west of the Salzgitter *gemeinde*, with Salzgitter Bad located in a gap cut through its southern end. East of the south-north Oker Valley there are three more such ridges (Oderwald, Asse, and Elm) and beyond the last lies the lowland in which Helmstedt is located.

Beneath this lowland lie important mineral resources (Fig. 2).[2] The northern Harz has long been an important seat of mining. Potash and rock salt have been exploited beneath the anticlinal ridges, but today are of little significance in this area. Around Helmstedt is the most westerly outlier of the brown coal fields of the middle Elbe area. But today major significance attaches to the iron ore deposits.

These iron ores, long known and intermittently exploited, were investigated by numerous borings in the thirties. The exploitable reserves were established at over two milliard tons. They are, however, low grade ores, with a metal content of some 30 per cent and a high silica content, some 25 per cent. The last was one of the main drawbacks to their exploitation until 1936, when a new process was patented for the extraction of sulphur from the pig iron. The ores, oolitic and coarse grained, occur in Lower Cretaceous strata in beds up to 100 meters thick and at depths up to 1000 meters. These strata were uplifted by the Saxonian folding and the iron bearing beds are steeply tilted and outcrop on the edges of the Salzgitter anticlinal ridge and dip sharply away from it. They cover a large area to the northeast towards Watenstedt and beyond Braunschweig itself, to depths of over 1000 meters, and in this area are basic in content, like the ores of the Peine district. The southern section (between Watenstedt and Peine) is now owned by the *Gewerkschaft Konrad*, in which the Salzgitter and Ilsede-Peine concerns participate jointly. Borings have given favorable results and an experimental shaft is to be sunken shortly. The northern section, north of Braunschweig, is held by a Ruhr concern, and its potential future production is estimated very tentatively at about 30 million tons per year from some 20 mines. This whole area contains the major iron ore reserves in Germany.

[2] Thanks are due Dr. Heinz Kolbe, geologist for the *Erzbergbau Salzgitter A.G.*, Salzgitter Bad, for materials on the geology of the iron ore deposits.

BRAUNSCHWEIG[3]

Braunschweig is the economic and cultural capital of this area. It was an outstanding medieval city and in the mid-19th century, with 39,000 inhabitants it still exceeded Hanover, with 32,000 inhabitants. It has lost ground since and now has less than one-half of the population of Hanover. But there lived in 1950 within 25 kilometers of Braunschweig 80 per cent of the population that lived within the same radius of Hanover (660,000 against 820,000 respectively). Moreover, the Braunschweig area increased its population by 87 per cent in the period 1933 to 1950 as compared with one-third in the Hanover area. These facts alone speak of abnormally rapid growth and an intimate association between Braunschweig and its immediate environs.

The city was the capital of a fragmented State. It lies somewhat south of the main west-east routes, and, owing to the barrier presented by the Harz, it lacks the through south-north communications of Hanover and Magdeburg. It has developed, however, a variety of industries, many of which are closely connected with its agricultural environs—the processing and packing of vegetables and beet sugar, the manufacture of packing materials and containers, and the production of agricultural machinery. More recently, there has been added a diversity of light skilled industries, such as the production of photographic apparatus, and heavier engineering industries. The city's population rose to 197,000 in 1939 and was showing signs of accelerated growth with the opening of the Mittelland canal and the beginning of Salzgitter and Wolfsburg. The historic city was terribly blitzed and its population in 1945 had fallen to only 136,000. The postwar recovery has been remarkable. The city now has 239,000 people, due in main to a large influx of refugees who now make up one-third of the total population. The city formulated its new reconstruction plan in 1953 and foresees a peak population of 275,000.

Braunschweig is closely connected with its countryside not only in its economic growth but also in regard to its labor supply. The daily movement of workers to the principal centers of employment in the area is shown in Figure 3. In 1950, about 16 per cent of its 113,000 workers traveled to Braunschweig from the agricultural villages in a wide surrounding area; and, until recent years, there was no overlap with the commuting orbits of neighboring urban centers. The structure of this labor market, and, in consequence, both housing and traffic problems, have changed during and since the war through the rapid growth of Salzgitter and Wolfsburg. This is evident from the commuting figures for 1950. Braunschweig had only 2400 out-commuters, i.e., workers who lived in the city but worked outside it. Of these, 1100 worked in Wolfsburg (traveling mainly by train) and 300 in Salzgitter. On the other hand, 860 workers traveled in daily from the Salzgitter area, but none from Wolfsburg. These movements have grown substantially—probably by 20 to 25 per cent—since 1950.

SALZGITTER[4]

Interest in the iron ore deposits south of Braunschweig culminated in the establishment by the Nazi government in July 15, 1937, of the *Reichswerke A. G.*

[3] Hans Evers: "Die Bevölkerungsstruktur der Stadt Braunschweig," *Kommunalpolitische Schriften der Stadt Braunschweig*, Heft 16, 1955, especially pp. 88–93.

[4] I am indebted to the municipal authority for a copy of a report entitled *Kommunalpolitische Probleme der Stadt Salzgitter*, 1954, 92 pages with many maps.

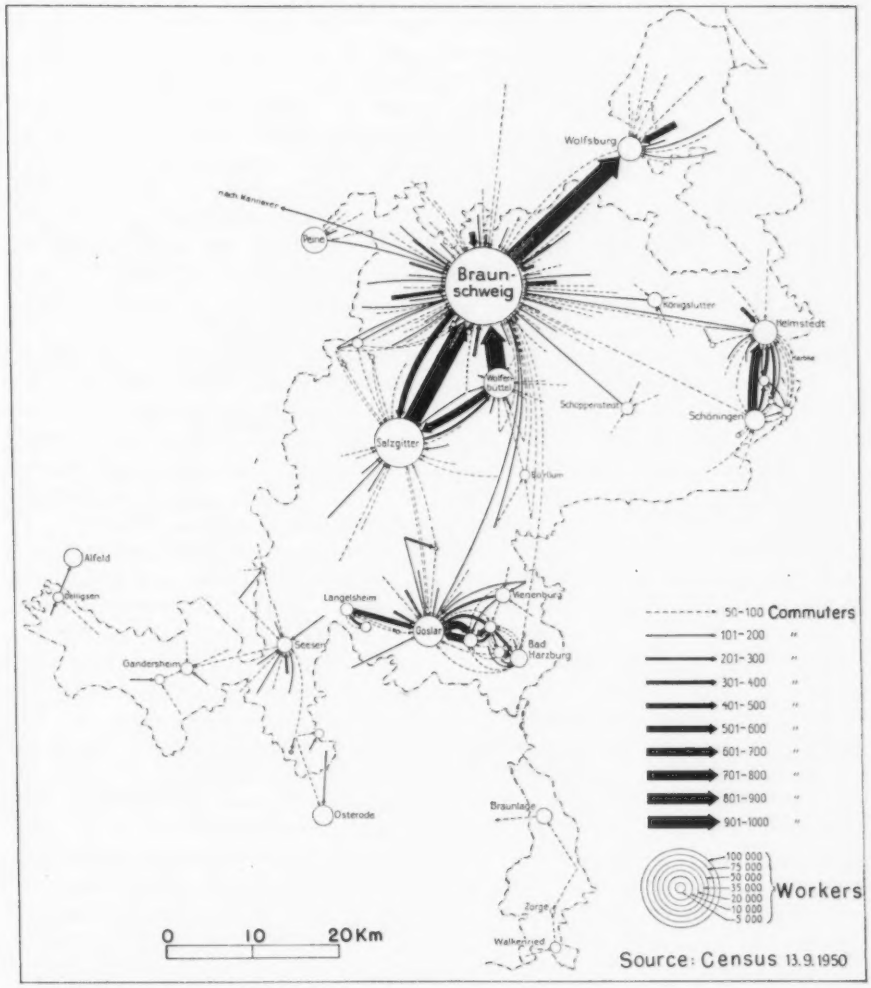


FIG. 3. Commuting in the Braunschweig area according to the census of September, 1950.

für Erzbergbau and Eisenhütten Hermann Göring. This is now part of the *A. G. Berg-und Hüttenbetriebe*, that has two subsidiaries in the area—*Hüttenwerk Salzgitter A.G.* and *Erzbergbau Salzgitter A.G.*—plus the other major concerns in the area, and coal mining interests in the Ruhr. Land was bought to the extent of 147 square kilometers and nearly 500 farmers displaced. This covers over one-half of the total area of the new *Stadtgemeinde*, that was formed in 1942 to permit the coordinated physical development of the whole enterprise.[5] This large *gemeinde* has an area of 216

[5] The name Salzgitter is derived from Salzgitter Bad. This is the only old established town in the immediate area, and its name suggests its early origin as a salt mining center, and its more recent growth for its medicinal waters. The whole *Stadtgemeinde* includes many separate places and their names are preceded by the name of Salzgitter, that is now given to the whole gemeinde e.g. Salzgitter-Watenstedt.

square kilometers and maximum dimensions of 20 kilometers from west to east and 30 kilometers from north to south, and embraced 29 separate rural *gemeinde*.

It was planned that production should total 20 million tons of ore per year, of which two-thirds was to be smelted locally, and one-third dispatched by canal to the Ruhr in exchange for coal needed for making coke to feed the furnaces. Several existing workings and pits were acquired and three large new pits and three new open quarries were begun in the ore yielding area in the Salzgitter ridge to the west. The village of Watenstedt was selected as the site of the main plant. Ultimate production was envisaged, through four stages of development, as reaching 4 to 5 million tons of steel, derived from a total of 32 furnaces, with 1000 kilometers of interconnecting railroad tracks and a feeder to the Mittelland canal (opened in 1939).

This vast project was begun in the spring of 1938 and an army of laborers was brought in for the purpose. The first blast furnace was tapped in October, 1939. Production proceeded with abnormal rapidity during the war. At the end of hostilities there were 12 furnaces, though only eight were in production, yielding a total of one million tons of pig iron per year. Six Thomas converters, three Siemens-Martin furnaces, and an electric furnace, produced between them 1.1 million tons of steel (two-thirds Thomas steel). There were 330 coke ovens producing 2.1 million tons of coke, based on coal brought mainly by canal from the Ruhr. The rolling mill was the largest single structure of its kind in Europe. Production collapsed with the end of hostilities. Demolition took place over the following years. By January, 1951, nine of the 12 furnaces were destroyed, as well as the whole of the steel works, all of the vast rolling mills down to their concrete foundations, and one-half of the coke producing capacity.

Reconstruction began slowly in the late forties, but has continued with remarkable rapidity in the fifties. The first coke oven went into production in March, 1949, and the first blast furnace was tapped in April of 1949. The production of iron ore rose to nearly 6 million tons in 1956. Four blast furnaces are now in operation, producing 730,000 tons of pig in 1956, and two furnaces under construction will bring capacity up to 1.3 million tons. Three Thomas converters have a combined annual productive capacity of 900,000 tons. Three Siemens-Martin furnaces were completed in 1953, each with 150 tons capacity. Total steel production in 1956 was 940,000 tons, made up of approximately equal shares of Thomas and Siemens-Martin steels. Coke production in 1956 reached 1.8 million tons. Large new rolling mills have been built. The power plant has an installed capacity of 290,000 kilowatts. A nitrogen plant with a capacity of 48,000 tons came into operation in July, 1956.

The industry has good prospects, but it must constantly face the basic problems of reducing production costs to compete effectively with Ruhr products. This problem is now particularly acute, since the Iron Curtain severs the industry from what might be regarded as its natural market territory. Salzgitter steel can be delivered, in terms of transportation costs, as far as the line of the Weser and Leine Rivers, beyond which it comes into competition with Ruhr steels. The present potential market of the Salzgitter area is thus a north-south belt in the eastern half of Western Germany.

This industrial development has profoundly transformed the area by the

rapid growth of large plants; by the urgent need, but slow relative growth, of dwellings for workers; and by the problem of providing adequate services for the population and transportation to and from their work. The main items are shown in Figure 4.

We turn first to the location of iron and steel production. This is in four phases—mines, processing plants, furnaces, and steel mills. Some 24 iron workings in all are shown in Figure 2 in the Salzgitter area (plus four in the Peine area and three in the Goslar area), 17 of which belong to the Erzbergbau Salzgitter concern. Of these, ten were in production in 1956 (plus two near Goslar and three near Peine), four belonging to the Salzgitter concern. The Salzgitter concern has seven open workings on the flanks of the Salzgitter ridge, but only one of these is at present in large scale production. The deepest mine shaft reaches 800 meters. Since the ores are low grade and acidic, and occur for the most part at such great depths, big technological advances were necessary to make feasible their exploitation. Mechanized working permits large production at minimum costs in the deep mines and the open workings at present in operation. Production in the mines with the newest equipment reaches 30 tons per man-shift.

The ores go direct from the mines in 75 ton wagons to the processing plants. The washing plant at Calbecht is situated due south of Watenstedt and within ten kilometers of the furthest pit. The ores are crushed and filtered with water so that large quantities of material are carried off and dumped as sediment. The iron content is thus raised to 40 per cent and the silica content reduced to 15 per cent. This wet concentrate is then transferred to an ore preparing plant (*Erzaufbereitung*), located eight kilometers to the northeast of the washing plant and adjacent to the furnaces at Watenstedt. This ore preparing plant, opened in 1942, receives 60 per cent of the concentrate, the rest being dispatched direct to the Ruhr. The concentrate is burned to form lumps, called *sinter* in German, with an iron content of 45 per cent. One-half of this is fed to the local furnaces and the other half goes partly to the Ilsede furnaces, but mainly to the Ruhr.

The main plant is situated at Watenstedt. Furnaces, rolling mills, steel works (*Famas*, short for *Fahrzeug und Maschinenbau*), coke ovens, and power plant (*Kraftwerk*) are all situated here on a compact area measuring about seven by three kilometers. The area is bounded to the west by the 18 kilometers branch canal of the Mittelland canal, that handles over 2 million tons of coal for the coke ovens and power plant.

A big influx of population accompanied this industrial development, and has resulted in the growth of several widely spaced residential centers. In 1937 the whole *gemeinde* was an undisturbed rural countryside, with many agricultural villages, spaced at intervals of some four kilometers in the midst of rich farmland. The population was 19,000, a large part of which was concentrated in Salzgitter Bad. This was the only historic town in the area, except for Wolfenbüttel, the old ducal capital, that lies in the Oker Valley just east of the *gemeinde*. The feverish activities of 1938 brought the population up to 45,000 in 1939. The big increase in production and the enforced shift of workers during the war brought up the population at the time of the arrival of the Americans to at least 130,000. Today it is 100,000.

The initial plans of 1937 envisaged a city with 130,000 residents at Lebenstedt, some seven kilometers west of

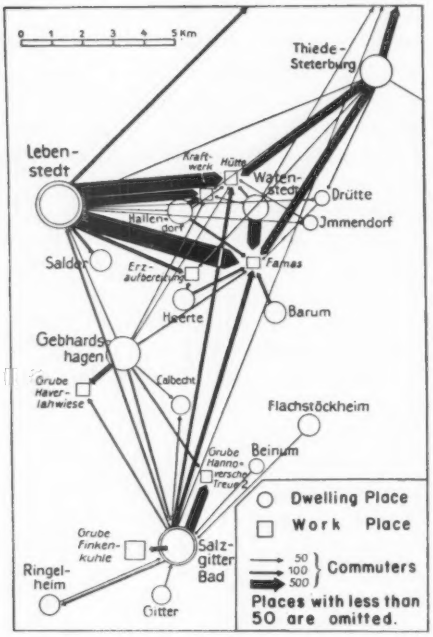


FIG. 4. Commuting in the Salzgitter area in September, 1949. (*From Hoffmann.*)

the industrial complex at Watenstedt. There was also to be a large increase of population at Salzgitter Bad and at other places. The final population of the whole *gemeinde* was foreseen as about 250,000. A start was made at Lebenstedt with a large oval-shaped urban plan, but buildings were erected only at the eastern end. Small housing projects were begun elsewhere just before the war, attached to villages, and likewise bearing their name—Steterburg (in the northeast near the canal), Hallendorf (immediately west of the industrial site), Gebhardshagen (on the eastern side of the ridge and housing mining workers), and Salzgitter Bad.

Today, out of the total population of 100,000, about 30,000 live in Lebenstedt, 24,000 in Salzgitter Bad, 8000 in Gebhardshagen, and 8000 in Steterburg. Only 5000 live in the midst of the industrial site at Watenstedt. Even before the war, and then right through it, the immigrant workers were housed in temporary wooden shacks right next door to their work. Watenstedt was the main center, where about 20,000 people lived. At the end of the war there was a great reshuffling of population, many people moving out and others coming in from the other side of the Iron Curtain. Three-quarters of the total population of the *gemeinde* are postwar German-speaking immigrants. The population of many of the villages is double the prewar figures. Though many of the huts have been demolished, they still house about 6000 people. There is an acute housing shortage. In the whole *gemeinde* the 100,000 people live in 22,000 dwelling units and 2000 emergency barracks. This population (ignoring future marriages and immigrants) will require 12,000 dwelling units, i.e., 1200 per year for a ten-year period. About 4500 dwellings have been built since the war, mainly since 1950. The demand for housing, communications, and community facilities far exceeds the capacity of the *gemeinde* to pay from its own taxes, and substantial support from the central government is essential.

Especially significant is the problem of the journey to work. This is shown in Figure 4 for 1949, the last date for which full data are at present available. In 1949–50 there were 32,000 employed and 14,000 unemployed. In October, 1956, there were 40,000 employed and unemployed had virtually disappeared (1700). Over one-half of the employed are in the iron and steel plants at Watenstedt and about 6000 in the iron mines. The rest work in Lebenstedt and Salzgitter Bad and in scattered villages. On the other hand, only about 5 per cent of the population, and thus presumably of the workers, live in

Watenstedt, whereas nearly a third live in Lebenstedt (almost all working in Watenstedt) and a quarter in Salzgitter Bad. Miners live in Salzgitter Bad and Gebhardshagen. The result is a remarkably large and complicated movement of workers from widely scattered dwelling places.

Full data of the daily movement of workers are not available since 1949,[6] but a census of the 6000 workers in the iron and steel plant was taken in 1954 and its results are shown in Figure 5. A second census was taken in mid-1956, when the number of employees had increased to 8000, though the pattern of movements remained essentially the same. About 3000 workers were then drawn from Lebenstedt, 830 from Steterburg, 730 from Salzgitter Bad, and 530 from Wolfenbüttel (east of the *gemeinde*). A few workers (less than 10 and in many cases less than 5) are drawn from each of over 100 places over a radial distance of 15 to 20 kilometers.

There is here, therefore, a double transportation problem—first, getting the 3000 workers to and from Lebenstedt and several hundred from each of several other dwelling centers; and, second, bringing several workers from each of many widely scattered villages. Lebenstedt lies between two east-west railroads, and workers had to be carried on the industrial lines of the company until the situation was improved by the opening of a new branch of the *Bundesbahn* through the town in November, 1954. The second problem concerns the cheapest and quickest way of travel to and from villages as well as from outlying sections of Lebenstedt itself. Down to the end of 1954 the company, in order to attract workers, paid their travel costs, subject to a

[6] The following data were supplied at the *Hütte*, in Salzgitter.

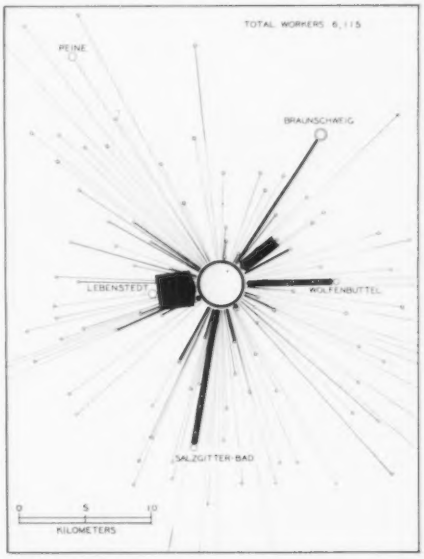


FIG. 5. Commuting to the iron and steel plant at Watenstedt-Salzgitter in 1954.

maximum of 25 D.M. per month. Cyclists received 3 D.M. per month. In January of 1955 these payments stopped and the company raised wages generally by 3½ per cent. One of the objectives of this change was to encourage workers to seek new dwellings nearer to their work. In July, 1956, 14 per cent of the workers used the *Bundesbahn*, 11 per cent the *Werksbahn*, 38 per cent autobus, and 37 per cent bicycle and other private means. In summer, the number traveling by bicycle is much higher than in winter. Bus services have been improved and offer the most rapid transportation from home to plant. This situation, common to all big plants located far from big cities, will continue as long as housing facilities are not available within a "reasonable" distance of the plant (in terms of time and cost) and at savings that offset those of living more cheaply at a much longer distance in scattered villages.

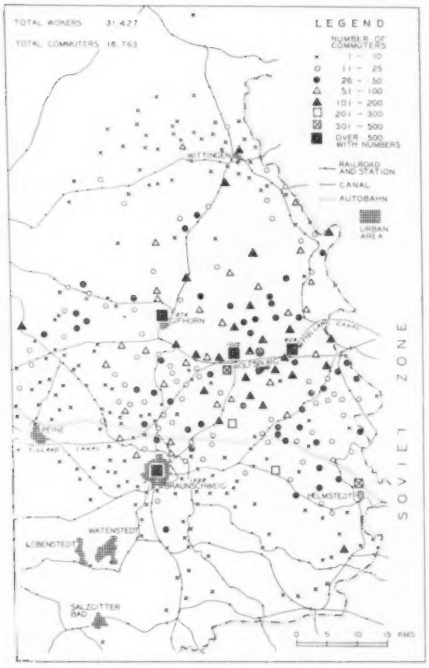


FIG. 6. Commuters to the Volkswagen plant in June 1955.

WOLFSBURG[7]

The Volkswagen Plant is situated at Wolfsburg, some 25 kilometers northeast of Braunschweig. The town was controlled and developed, until 1945, by the Nazi *Deutsche Arbeitsfront*. A locality was sought alongside the railroad and the canal that, at the same time, would be near to the big reservoir of unemployment (in the thirties) in Thuringia and Saxony. The exact site was obtained by negotiation with two large landowners, and no existing agricultural villages were disturbed. The site includes the low flat land on the floor of a glacial trough, with the closely settled loess land of the *Börde* to the south and the thinly settled poor sandy terrains on the southern border of the Lüneburg Heath to the north. The plant and the town were inaugurated by Hitler himself from a wooded hill that overlooks the site from the south. The plant produced airplane equipment during the war. In 1945 it employed 3300 people and supported 14,000 living in the town, most of them in temporary wooden barracks and most of them natives of Thuringia and Saxony. The plant was seriously damaged by bombardment in 1945. It has been reconstructed since for the production of *Volkswagen* automobiles, and output has increased with spectacular rapidity. An employment roll of 7000 in 1946 climbed steadily to 30,000 in 1955. Most of the workers and their families since 1945 have been derived from released war prisoners in the area, later from refugees, and from workers in the surrounding area. One-half of all the workers and nine-tenths of the commuters are refugees.

The establishment consists of one vast plant on the north side of the canal and railroad in the midst of open country. In 1955 it was turning out 1200 cars and 200 trucks per day. (The production of trucks with 3000 employees was shifted to a new plant in Hanover at the end of 1955.) Virtually all of the cars are delivered from the plant by rail. Transportation facilities are not adequately developed by truck to permit the use of road transport. Sheet steel, to the extent of 650 tons daily, reaches the plant mainly by rail. Coal consumption is 800 tons daily and this is brought in exclusively by canal. The rapid production of this plant has depended on the growth of the export trade rather than on the domestic market, and there is a very large direct shipment from the plant to Hamburg for overseas destinations.

In 1939 there was no settlement on

[7] From data supplied by the *Volkswagen* concern, including the detailed figures of commuting shown on the map.

this site. Its growth has been due entirely to the one plant. Its labor has been recruited entirely from "outside." Housing has been quite unable to keep pace with the rapid growth of employment and consequently workers are drawn by daily commuting from a wide surrounding area. Total employment now exceeds 30,000. There are about 19,000 commuters who work in the plant, as against some 12,000 who live in Wolfsburg. The range of commuters is shown in Figure 6. In 1945 no workers were employed who lived more than five kilometers from the plant. Later the radius was increased to ten kilometers. Since private concerns found it unprofitable to collect patrons from many scattered points within this radius, the company had to provide the service. In view of the steady increase of labor need, restrictions on the radius of travel were soon lifted and workers come in from numerous scattered points in the heathlands to the north from as far as 50 kilometers; and considerable numbers are drawn by rail from Braunschweig, and even Hanover and Gifhorn. The firm still has a few of its own buses in operation, but today private buses and railroad carry the bulk of the workers. The company, however, will not sign on a worker unless he has guaranteed daily bus transportation, and a journey of 1½ hours is considered a maximum for the worker has to be at his bench at 8 a.m. The long term objective, however, of the Volkswagen concern, is to cut down the journey to work, which is considered as something of an emergency problem, and to get as many of their workers as possible permanently housed in Wolfsburg. The great majority of the commuters from the surrounding villages are refugees who are living under emergency conditions and the Plant estimates that one-third of them are ready to move into homes in Wolfsburg. But, evidently, most of them prefer to stay in the country and travel daily to their work.

Wolfsburg began as another grandiose Nazi plan and was envisaged in 1937 as ultimately housing 100,000 people. The initial plan of the city, grouped around a central acropolis, was given up after the war, since, in those pessimistic days, it was believed that the city would never exceed 25,000 people. The original, well-designed plan was sacrificed and the place was allowed to develop on a more short-sighted basis. Control passed from the Nazi *Arbeitsfront* to the city authority. The Plant has given substantial financial assistance to the city, and, through its subsidiary building associations, has been responsible for at least one-half of the postwar dwellings. The city is supplied with hot water by pipes from the Plant and the Plant has also built a swimming pool and will finance the theatre. Seven elementary schools and one high school have recently been completed and two churches were designed by foremost German architects. There is a current shortage of 5000 dwellings but building is now going on rapidly.

The great increase of population in the surrounding *gemeinden* (many of which have doubled their numbers since 1939) and the ever-increasing job opportunities offered by the Volkswagen plant, are having a profound impact on these country communities. Dwellings and services are needed that strain village tax resources and require planned cooperation. Historic little towns such as Fallersleben and Vorsfelde are fast becoming small "dormitories." It would appear that some 115,000 people are directly or indirectly dependent on the Volkswagen plant. About 80,000 live within the nearer environs of Wolfsburg, and the town itself has about 50,000 in-

habitants. As its services increase so the ties with its environs become closer.[8]

Wolfsburg, more so than Salzgitter, is an example of lopsided urban growth. One vast plant offers just about the highest wages of any concern in Germany (average is a good 100 D.M. per month) and monopolizes the local labor market. It is thus impossible for other plants to get in and the whole community is dependent on the fortunes of automobile production and the export market. There is, moreover, not the same demand for labor by females as there is in Salzgitter, where lower wage levels encourage the women to find jobs. New industries are gradually being introduced in the Salzgitter area, where there are several small centers, to balance the employment in terms of skills and sex. This is more difficult in Wolfsburg, where all employment is concentrated in one community.

THE TRANSPORTATION PROBLEM[9]

It will be apparent from the foregoing that a major problem of this Braunschweig area is concerned with the improvement of communications, both within the area and with the outside. This problem has been seriously increased by the change in location that has come about through the erection of the Iron Curtain between the Allied and the Soviet Zones of occupation.

There is a long-recognized need, that now assumes real urgency, for the improvement of through routes. The railroad pattern and future plans are shown in Figure 7 and road pattern and plans in Figure 8. Braunschweig was the capital of a small State during the railroad building era. Though it built the first State-owned railroad in the world—from Braunschweig to Bad Harzburg (near Goslar)—it was unable to compete with Prussia in the construction of a major railroad network. The main west-east route from the Ruhr to Berlin was built by Prussia on its own soil and thus skirted the north of Braunschweig territory. Braunschweig to this day lies south of this main route. The city has only one station. This is a "dead end" terminal and only a few trains from Hanover to Magdeburg pass through it, with obvious delay and increased cost. Similarly, the north-south railroads were built through Hanover and up the Leine trough, so that Braunschweig lacks direct main routes (by road as well as by rail) to north and south, both for political reasons and because the direct path of routes to the south is barred by the Harz Mountains.

In order to overcome these disadvantages, plans have been put forward, as shown in Figure 7, for establishing main tracks from Braunschweig northwards to Wolfsburg and thence to Hamburg; and southwards (skirting Watenstedt) to Salzgitter Bad so as to connect with the main route south to Frankfurt and Munich. The Wolfsburg-Braunschweig connection would serve to interconnect Salzgitter, Braunschweig, and Wolfsburg. It would also serve as an alternative to the main west-east route from Cologne to Berlin, with the addition of only 15 minutes to the existing main route schedule. Such changes will only be effective, however, when the long-designed reconstruction of the Braunschweig railroad station and yards is carried into effect on the southeastern outskirts of the city. A new route through Watenstedt and Lebenstedt was opened in November, 1954, and eases the commuting situation here.

[8] Peter Koller: "Die Volkswagen Stadt Wolfsburg," *Raumforschung und Raumordnung*, Heft 4, 1956, pp. 202–210.

[9] These transportation problems are a primary concern of the authorities of the Administrative District of Braunschweig and make up the essential purpose of the report presented to its President by Dr. R. Hoffmann. (See footnote 1.)

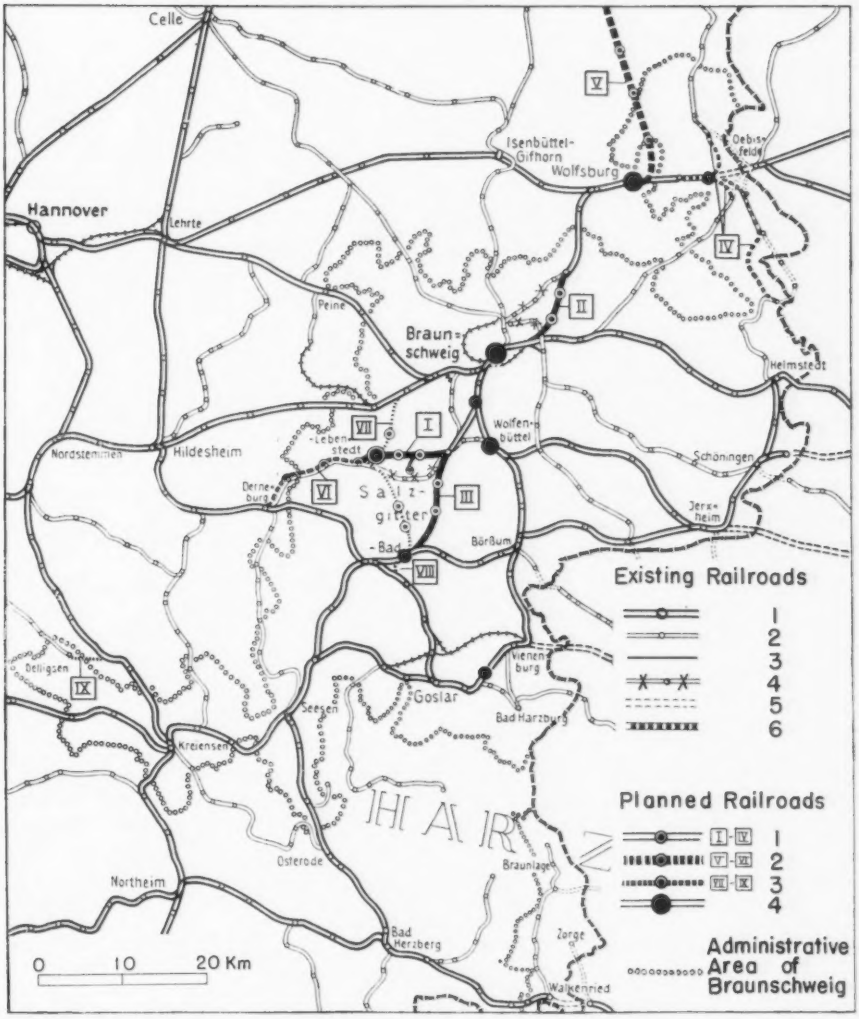


FIG. 7. Railroad plan for the Braunschweig area. Existing railroads—1, main; 2, local; 3, freight; 4, to be unused; 5, unused near the zonal boundary; 6, unused but to be reopened. Planned railroads—order of priority: 1, urgent (1 under construction); 2, after completion of 1; 3, later additions; 4, new stations on existing railroads. (*From Hoffmann.*)

The southward extension of the line from near Watenstedt to Salzgitter Bad, begun before the war, is now being completed.

Through road connections are also needed, as shown in Figure 8. The special question here is the north-south autobahn. This, as planned, will run south from Hamburg to the east of Hanover and Hildesheim, and up the Leine trough to Göttingen, so as to link with the existing autobahn to Frankfurt. It is proposed that a connecting autobahn be built from near Wolfsburg on the west-east autobahn, through Watenstedt and Lebenstedt,

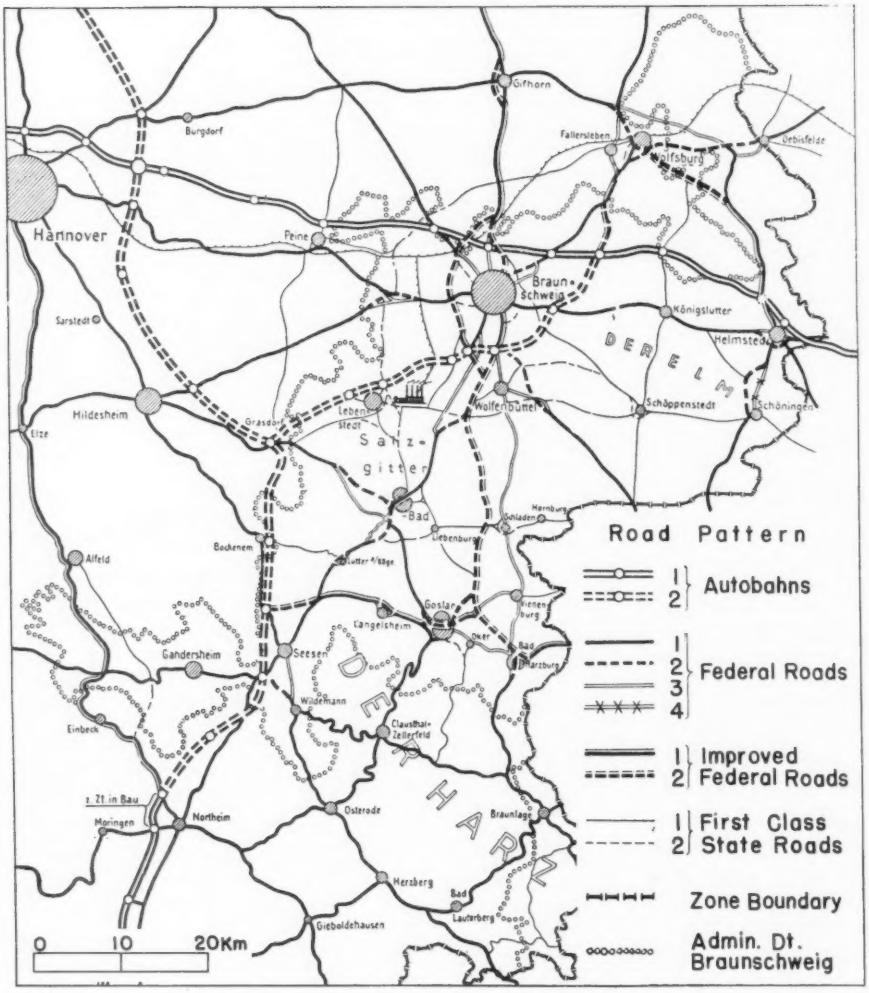


FIG. 8. Road plan for the Braunschweig area. (*From Hoffmann.*) Autobahns—1, existing, and 2, planned. Federal roads—1, existing; 2, planned. 3, State roads; 4, to be abandoned. Improved federal roads—1, existing, and 2, planned. First class State roads—1, existing, and 2, planned.

to the north-south autobahn. A new road to the west of Braunschweig will complete a ring-road around the city at a radius of five kilometers from the center.

As for canal connections, the area has access by the Mittelland canal to the Weser and so through to Bremen. The improvement of the Weser navigation upstream to Minden, now under construction, will be advantageous to the Braunschweig area. The old plan for a canal north from Braunschweig is again being discussed, and to this end a *Nordsüdkanal Verein* was founded in 1951 with its seat in Lüneburg. This canal would connect the lower Elbe via Lüneburg with the Mittelland canal

near Wolfsburg. The proposed rail and road plans will be an adequate program for 10 to 20 years, and not until then is the canal likely to be seriously considered.

The location of the Braunschweig area presents special problems with respect to both communications and general market orientation.

First, Braunschweig was a regional center of the first order until the middle of the 19th century. It was, and is, the focus of a close network of highways, and, even though outdistanced by Hanover and Magdeburg, it nevertheless has a close network of local roads and railroads. In recent decades, for reasons discussed, the population of the area (25 kilometers radius) is fast overtaking that of the Hanover area. The growth of Salzgitter and Wolfsburg has more than outdistanced the local transportation facilities.

Second, the zonal boundary between the British and Soviet zones, and now between the two German States, severs in dramatic fashion a complex fabric of routes and traffic and passenger flows between the complementary eastern and western parts of the prewar Reich. This situation is especially true of the Braunschweig area that lies immediately west of the dividing line. Instead of occupying a central position in the German State, it now lies in a cul-de-sac, like the rest of the belt alongside the Iron Curtain.

A third problem arises from the fact that the zonal boundary cuts across lines of local communications and through the local orbits of small towns.[10] Five main railroads and ten lesser railroads are severed in the Braunschweig area. Stations nearest to the zonal frontier (that may be as far as eight kilometers from it) are now "dead ends," and certain tracks have even been abandoned. For example, as shown on Figure 7, the railroad east from Wolfsburg is severed just west of the little town of Oebisfelde, so that the main route as well as two branch lines to north and south from this town are cut. Thus Wolfsburg, with its large stream of commuters, finds that the railroads to the north and south are broken, and 700 commuters from the Helmstedt area to the southeast must come daily by roundabout routes on inadequate roads by bus. It is planned to build connections between these north and south branch lines and the main-east-west route on this side of the zonal boundary. The frontier zone has many other such cases of disruptions of local communications, but they are particularly acute here because of the rapid growth of Wolfsburg and the wide extension of its commuting and trading areas that are developing rapidly as the city grows in size.

In conclusion, the Braunschweig industrial area bids fair to become one of the major industrial complexes of Germany. It is effectively adjusted to some of the disadvantages of its postwar location near to the Iron Curtain. But the provision of transportation facilities, housing, and services is urgently needed to catch up with the area's rapid industrial growth, and to afford a more effective framework for its balanced economic growth.

[10] Fortunately the supplies of electricity, gas, and water are more than sufficient for the needs of the area and have not been seriously disrupted by the zonal frontier. The brown-coal power plant east of Helmstedt (at Harbke) ceased to service the area in May, 1952, but the large coal power plant at Watenstedt (Hallendorf), the largest in Lower Saxony, more than meets the needs of the area.

IRRIGATION IN JORDAN

H. R. J. Davies

Mr. Davies, Lecturer in Geography at the University of Khartoum, spent five to six weeks in Jordan in 1956.

NO visitor arriving in Jordan in August would be surprised to learn that shortage of water is one of the country's chief problems. Bare, brown hillsides and dried up watercourses he will find all around him. Some 88 per cent of the country receives less than 200 mms. annual rainfall, and 95 per cent less than 400 mms. Rainfall tends to decrease both from north to south and from west to east, unless influenced by altitude. The hills east and west of the Jordan River have a higher rainfall. The Jordan Rift Valley is in a deep rain shadow between them. Rainfall is everywhere confined to the winter half year.

Most of the irrigation schemes (Fig. 1) are to be found in the Rift Valley which south of Jordan's northern frontier falls into Köppen's BS climate, and south of Jisr Damiya into his BW climate. Herein are to be found nearly all the perennial rivers of the country. The most southerly is the Wadi Feifa, a short distance south of the Dead Sea. Here also are level lands which can be easily irrigated. Beyond the hills east of the Jordan lie the level lands of the Sirhan Depression, stretching southeastwards from Azraq. Here there are no perennial streams and the underground water supply is almost unexplored. Some parts may become important irrigation areas in the future, but at present it is a barren waste. In the hill regions shortage of level land restricts irrigation to tiny patches in the valley bottoms (Fig. 2). Well irrigation is important, however, in the Hebron district and some other places. The relatively higher rainfall of the hills makes irrigation less essential in the northern half of the country.

The Jordan Rift Valley is not wholly flat although it contains areas of irrigable land. Between the Sea of Tiberias and the Dead Sea the valley bottom falls from −212 meters to −392 meters. South of the Dead Sea it rises gradually to a height of 200 meters and then drops again to sea level at Aqaba. Between the Sea of Tiberias and the Dead Sea, the valley falls into three distinct regions (Fig. 3). Along the River Jordan lies a narrow flood plain (the Zor). Above this on both sides is a bench (the Ghor). Between the two lies a narrow dissected zone (the Qattar). To the east and west of the Ghor rise the hills forming the edge of the Rift. The Ghor itself is dissected by the tributaries of the Jordan, which are more numerous on the east bank than on the west. Generally, an alluvial fan is built up at the point of debouchement from the hills. These features are repeated in some areas to the south of the Dead Sea.

Irrigation in the Jordan Rift Valley

The irrigation methods vary. The Zor schemes are all low-lift pump schemes from the River Jordan. These schemes are small, usually less than 100 acres in extent. They are financed

by either U.N.R.W.A. (United Nations Relief and Works Agency) or privately and may number about 50. The Salmon Abu Gereiban scheme, financed by U.N.R.W.A. and situated on the east bank a little north of Tell Deir Alla, is representative. It is a scheme of 125 acres, and like many others its size is restricted by the meanderings of the river. The scheme is supplied with water by gravity flow from a low lift pump sited on the outside of a meander bend in order to combat the river's seasonal rise and fall. The presence of abandoned meanders within the scheme has made bulldozing necessary to level the land. The soil is mostly fertile Jordan clay, but there are patches of poor sands. The distance from the nearest proper road is four kilometers. Bad communications are a handicap to many Zor schemes. Some U.N.R.W.A. schemes were begun to settle nomad refugees.

Salt is rarely a problem in the Zor. The River Jordan on leaving the Sea of Tiberias is somewhat salty but is soon diluted by the Yarmouk. Southwards the main river becomes progressively more salty. The chlorine content increases from 300 parts per million at Jisr Sheikh Hussein, to 450 parts at Jisr Damiya, and to 600 parts at Allenby Bridge.[1] Tributaries which have crossed the salty Ghor, and evaporation losses, account for this. This salt content is not high enough to vitiate irrigation, and the river by its continual washing has kept most of the Zor salt free. Where sulphur and salt do impair the silts it is thought to be due to gypsum concentrations in the Qattar which are broken down by bacterial activity, and may be carried down into the Zor by rain showers. Salt may also be carried down, but some of the landholders claim that the wind blows it down.

FIG. 1. Irrigation in the Hashemite Kingdom of Jordan.

The chief crops grown on the areas covered by these schemes are vegetables, especially tomatoes, cucumbers, and potatoes; fruits, especially bananas and watermelons; and small crops of cereals.

On the Ghor irrigation methods are more varied. There is one reservoir which is used for irrigation. This is at Jisr el Majamee, on the site of the old Jewish settlement of Naharayim, near the junction of the Yarmouk and Jordan (Fig. 4). The old reservoir for the power station is now used for irrigation purposes. The scheme is an U.N.R.W.A. project for Arab refugees begun in 1955.

[1] Information supplied by Director of Irrigation, Amman.

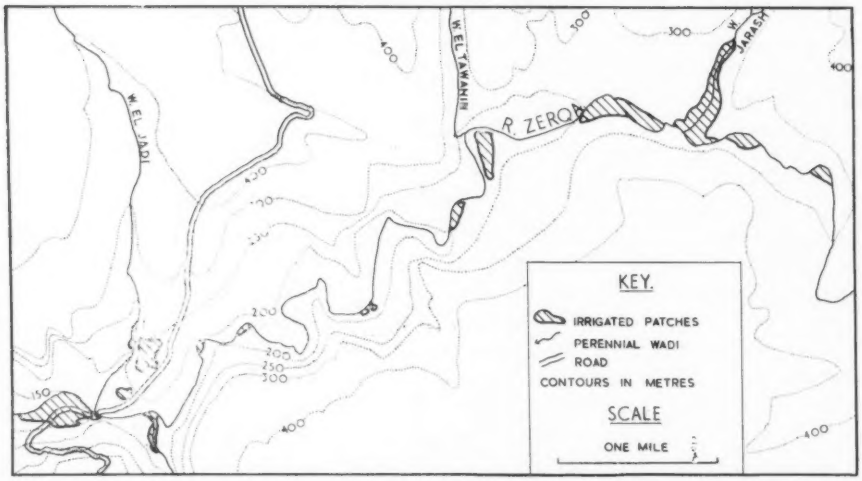


FIG. 2. Irrigated areas in a portion of the Zerqa Valley, within the hills east of the River Jordan (Figures 2 and 7 are based on aerial photographs held by the Range and Water Resources Section of the H. K. J. and U. S. A. Co-operative Department of Agriculture, Amman).

It was originally intended to irrigate some 3100 out of a total of some 4250 dunums[2] comprising the scheme. It was decided instead to settle 70 families, each with six dunums of perennial canal irrigation and one dunum of sprinkler irrigated crops should be bananas, citrus, and vegetables: and to this end each family is being issued with 300 banana suckers, 140 citrus fruit trees, and 1.75 Jordan dinars[3] worth of vegetable seeds.

This is the only dam used to impound

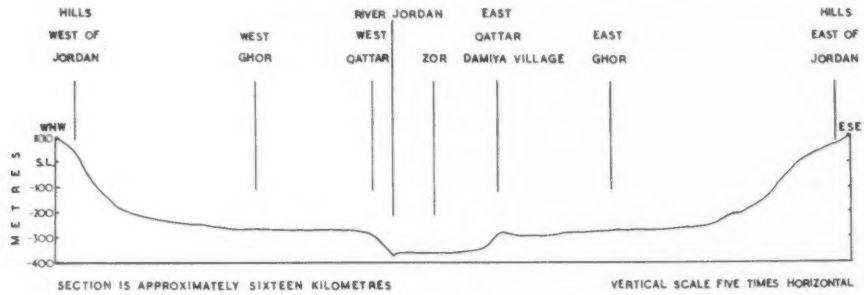


FIG. 3. Section across Jordan Valley near Jisr Damiya.

irrigation, with a further 45 dunums of communally operated canal irrigation, giving a total of 535 irrigated dunums. Each family would also receive 40 dunums of unirrigated land. The scheme is very closely situated to Köppen's BS/H line. It is intended that the chief water for irrigation in the country. The steep gradient of most wadis would entail a high and costly dam for an adequate volume of water to be impounded.

Unlike many parts of the Ghor the Jisr el Majamee area does not contain salty soils. Elsewhere in the Ghor

[2] 1 dunum = approximately ¼ acre.

[3] 1 Jordan dinar = £1.

and the Qattar, salt is due to the former presence of the Dead Sea. Salt is most concentrated in the Ghor in two areas: the first, just to the north of the Dead Sea, in the area most recently vacated by it; and the second, just north of Jisr Damiya, where the valley is constricted. In any portion of the Ghor, salt tends to be more concentrated away from the hills towards the Qattar, and away from the tributary valleys crossing the Ghor. This is because these areas are washed by salt-free waters running off the hills and along the wadis. Irrigation is confined to those areas which are less salty or where salt free water is available. Unfortunately, most of the underground water away from the wadis and hills is saline.

The largest irrigation schemes in Jordan are wadi diversions. Here the great problem is shortage of water. Only perennial streams can be used, and at present the works are incapable of storing flood waters. Ten wadi diversions are under the Director of Irrigation. The commanded areas vary from the 11,000 dunums of the Wadi Ziqlab to the 50,000 dunums of the Wadi Zerqa. In many districts the commanded area is considerably greater than the wadi is capable of serving in any one year, and a system of rotational irrigation on a three or four year basis is practiced. This rotation is not fixed. The amount cultivated in any one year depends upon the amount of water in the wadi and the amount of rain received. During the winter of 1955–56, 90 per cent of Wadi Hisban's 22,000 dunums were irrigated. Normally they are cultivated on a three year cycle. The amount of land irrigated also differs with the seasons. During the dry summer months the wadis shrink and evaporation is high and so the irrigated area is smaller than in winter. The discharge of Wadi Zerqa averages 137 decasecs in August against 578 in December.[4]

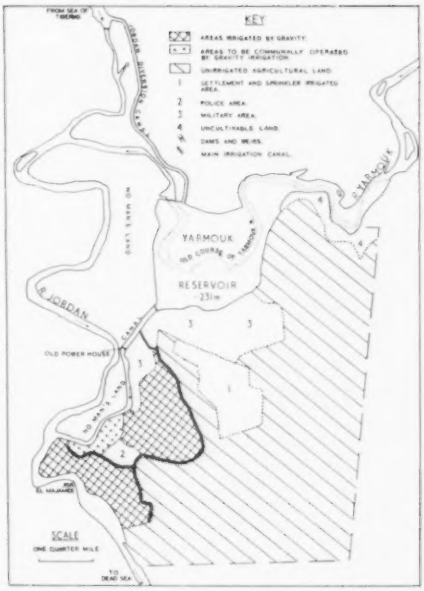


FIG. 4. Jisr el Majamee: refugee resettlement scheme. (Based on map held by U.N.R.W.A., Jebel Amman, Amman.)

Two important wadis, the Yabis and the Rajib, have "primitive" wadi diversions. The latter is scheduled to be provided with concrete canals and weir in 1957. Jordanian law states that two-thirds of the operators must agree before the government can interfere. At Wadi Yabis one influential landholder whose lands are situated near the present take-off point has persuaded the others not to have government interference. He stands to lose by an even distribution of the waters. On the "primitive" schemes the diversion consists of a pile of stones and earth across the stream, diverting the water into earth canals on each side. There is endless trouble over the division of the waters especially if the wadi

[4] These figures are based on discharge tables in the Department of Irrigation, Amman. Average for the period 1950–51 to 1954–55. The figure excludes sudden surges of flood water.

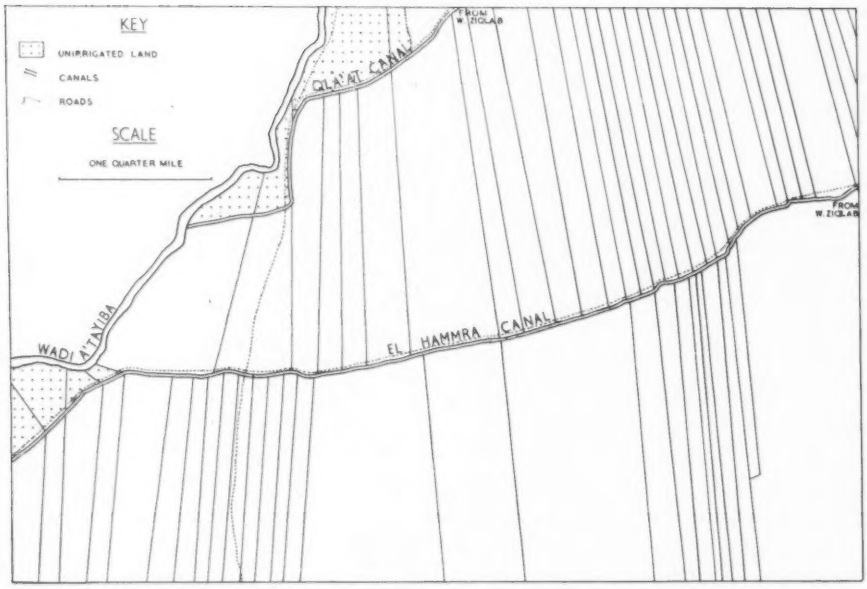


FIG. 5. Field patterns in a portion of the Wadi Ziqlab irrigation scheme. Before modernization this scheme was communally operated. (Figures 5 and 6 based on maps held by Department of Irrigation, Amman.)

slightly changes its course after a period in spate, or if the irrigation works are washed away. In dry weather especially, the people upstream get more than their share of the water. The government schemes represent a great improvement, because all landholders receive their fair share of the water. The replacement of stones and earth by concrete saves water otherwise lost by collapsed banks and seepage. Seepage losses from earth canals frequently reach 12 per cent per kilometer and on sandy loams reach 25 per cent. The Wadi Zerqa before government supervision was rotationally irrigated. Now this is unnecessary owing to the better use of the water available.

The schemes before government modernization were of two types, either communally or individually operated. Jordanian law states that holdings on government supervised schemes should be individually held, and that each owner should have a frontage on to a canal. After modernization supervized by the government those originally communally operated show neat straight lines for field boundaries (Fig. 5), whereas the others have a chaotic appearance (Fig. 6). Some of the field boundary meanderings would seem to be caused by water's tendency to develop any inequalities in its path.

Some diversions on the Ghor are supplemented by wells or springs. Wadi el Jurum is an example of the first, and the private scheme at Adasiya is an example of the second. The diversions are approximately sited on the −200 meter contour, with a paradoxical tendency to be lower in the north and higher in the south. The shortage of perennial wadi's accounts for the shortage of this type of scheme on the west bank.

Two important schemes situated farther south must be mentioned. First is

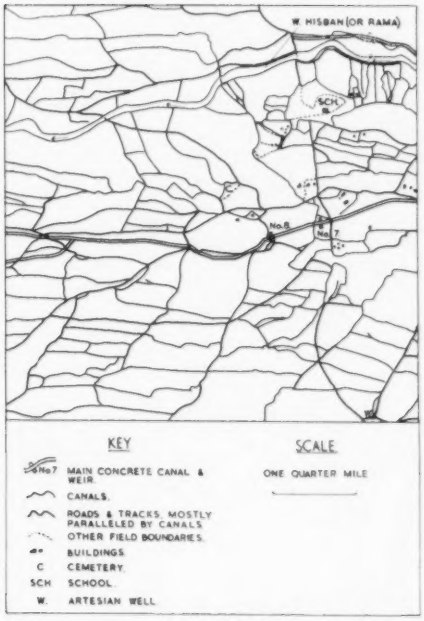


FIG. 6. Field patterns in Wadi Hisban irrigation scheme. (See source credit under Figure 5.)

the privately owned el Lisan scheme (Fig. 7) using Wadis Karak and Ibn Hammad. This is a scheme of some 10,000 dunums. Water in the alluvial fans is used, as well as the wadi water. The second scheme is south of the Dead Sea using Wadis Feifa and el Hasa. This scheme was constructed by the government before the end of the Mandate out of rent for water from these two wadis, paid by the Palestine Potash Company to the Transjordan Government. The Company used only half of the water. Wadi and alluvial fan water is used as at el Lisan.

Two perennial wadis are not utilized at all, the Wadis Zarqa Ma'in and Mujib, because they fall precipitately into the Dead Sea and have no irrigable land.

The other schemes on the Ghor are dependent largely on either springs or wells. The main scheme based on a spring is the veritable oasis of Jericho with its many date palms. It is a government supervised scheme serving some 4,000 dunums, with an estimated population for Jericho Sub-District in 1955 of nearly 55,000.[5] The other government operated scheme on the Ghor is at Marj Naaja with an irrigated area of some 600 dunums. It is a refugee scheme with 30 families, giving 20 dunums per family. The scheme is provided with water from three wells. There are proposals for extending the scheme up to 6000 or 7000 dunums. This scheme is situated on one of the saltiest parts of the Ghor, on the west bank of the Jordan above Jisr Damiya. The scheme began under U.N.R.W.A. auspices in 1952. The percentage of

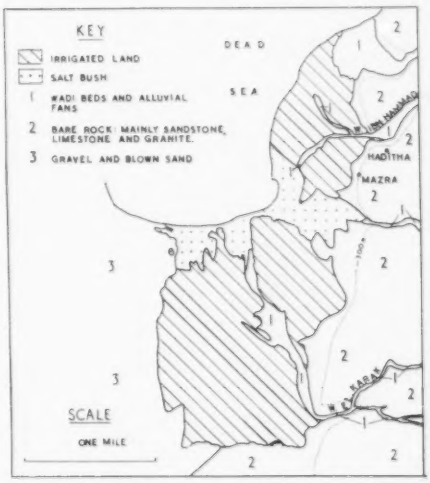


FIG. 7. El Lisan: areas irrigated from Wadis Karak and Ibn Hammad. (See source credit under Figure 2.)

soluble salts was then nearly two. Today it is about 0.75 per cent. This has been possible because the underground water here is sweet and the irrigation has washed the salt out.

[5] *Hashemite Kingdom of Jordan Statistical Yearbook*, 1955, Department of Statistics, Amman.

Such an unfavorable site had to be chosen because it was Crown Land, and therefore available for development without purchase. Much of the still unused Ghor has saline underground water. Many of the private well schemes along the Allenby Bridge road must be considered marginal for this reason.

On the Ghor the chief crops irrigated are cereals, vegetables, and fruit. The cereals are generally irrigated three or four times during their growing period. The number of times depends upon the lack or otherwise of rainfall. In good years irrigation may not be necessary in the north. Wheat is the chief cereal grown in winter, and millet in summer. The chief vegetable is the tomato. The total area under this crop in Jordan in 1955 was some 95,000 dunums[6] of which a half is thought to be irrigated.[7] It is mainly a winter crop in the Jordan Valley. After June, yields fall off due to the heat. This is in contrast with the upland areas where it is a summer crop. Some of the more southerly schemes, for example el Lisan, make a good profit out of producing very early tomatoes. Other major vegetables include cucumber, cabbage, and cauliflower. The major fruits grown are bananas and citrus. The valley is too hot in summer for temperate fruit trees. Most of the bananas are confined to schemes with a more reliable water supply as, in the north, on the Wadi Zerqa, and under well irrigation. Citrus fruits are similarly distributed, the orange being most important. Jericho is the chief banana center of the country; whereas Hebron, outside the Jordan Valley, is the most important citrus center. Grapes are also grown under irrigation. Some schemes have their own specialties. The Wadi Zerqa is the chief seed bed for tobacco, which with the coming of spring is transplanted from there to the mountains. Amman is the chief tobacco processing center. Jericho is the center for Jordan date production. Although not rivalling the Iraqi dates in quality, fresh dates from Jericho find a ready market in the main towns of Jordan. Irrigated berseem is grown for fodder in some areas. Berseem demands less water than alfalfa, will grow during the winter when more water is available, and produces as much per acre in seven months as alfalfa does in 12. The normal irrigation period for regularly irrigated crops is every 10 to 14 days in winter, and every six to seven days in summer.

THE IMPORTANCE OF IRRIGATION IN JORDAN

Although the actual percentage of cultivated land in Jordan irrigated is very small, and considerably less than five,[8] irrigated crops play an important part in the economy of the country. Internally they supply a small, but important, fraction of the country's food grains, with considerably higher yields than on unirrigated land. A very much larger percentage of their cropped land is under crops other than grain, and very much higher yields of these crops are obtained (Table I). They produce much of the citrus fruit; all the bananas and dates; half of the tomatoes; important percentages of the cucumbers and other vegetables; and a small portion of the grape harvest. In the external trade irrigated crops assume great importance. Tomatoes were sec-

[6] *Hashemite Kingdom of Jordan Statistical Yearbook*, 1955. Department of Statistics, Amman.

[7] Estimate of Chief Horticulturalist, Hashemite Kingdom of Jordan and United States of America Co-operative Department of Agriculture.

[8] Estimate of Chief Field Agricultural Officer, U.N.R.W.A. Amman. There are no statistics.

TABLE I

THE EFFECTS OF IRRIGATION ON YIELD AND TYPE OF CROP GROWN IN JORDAN

(Calculated from data in *Hashemite Kingdom of Jordan Statistical Yearbook*, 1955, Department of Statistics, Amman)

	Amman subdistrict (very little irrigation)	*Jericho subdistrict (nearly all crops irrigated)*
Yields:	Wheat.....0.35 *cwts.* per dunum.	.....5.00 *cwts.* per dunum
	Tomatoes.....6.00 " " " .	.....6.66 " " " (cf. Karak subdistrict under irrigation 12.2 *cwts.* per dunum)
Percentage of cropped land:	Grains.....91	52
	Bananas, citrus fruit, dates, tomatoes, cucumbers ... 0.41	.....28.0

ond to phosphates, and bananas held fourth place in Jordan's export trade in 1955. Together they account for 76 per cent of her exports to Iraq, 28 per cent of those to Kuwait, 21 per cent of those to Syria, 11 per cent of those to Saudi Arabia, and 5 per cent of those to the Lebanon. These five countries took some 75 per cent of Jordan's exports.[9] To Jordan her export trade is vital because she has one of the most adverse trade balances in the world.[10]

FUTURE OF IRRIGATION IN JORDAN

Nearly all the modern schemes date from after the Arab-Israeli War, which brought an influx of refugees in its train. Further extension of the irrigated area seems imperative if the country is to narrow its trade gap, raise its standard of living, and provide for its refugees. It is quite certain that the River Jordan and its tributaries, especially the Yarmouk, are not being fully utilized. But so far no satisfactory scheme has been worked out which would not require some form of Israeli co-operation, which in the present situation would appear impossible. The Bunger, Johnston, Baker Harza, and other plans will not become realistic until the political situation is settled. Schemes using the Yarmouk only would be wasteful, and the increased salt content of the Jordan might endanger the present Zor schemes. Until the political problem is solved it seems likely that attention will be focused on the possibility of using the water at Azraq at the northern end of the Sirhan Depression. Perennial sweet water springs are to be found here, and are conservatively estimated as sufficient for 30,000 dunums of irrigated land. After considerable exploration an area of 70,000 dunums of suitable land has been discovered. The main problem left to be solved would appear to be an economic one. What crops of sufficient value can be grown in order to make the scheme pay for itself? In the Jordan Valley we can expect further expansion of irrigation in the Zor with the aid of low lift pumps, and in well irrigation on the Ghor, providing suitable water can be found.

[9] Calculated from figures in *Hashemite Kingdom of Jordan Statistical Yearbook* 1955, Department of Statistics, Amman.

[10] *Digest of Jordan's Trade for 1954*, dated December 1955. H. K. J. and U. S. A. Co-operative Department of Economics and Trade, Amman.

POPULATION: A CHALLENGE TO CALIFORNIA'S CHANGING CITRUS INDUSTRY

Paul F. Griffin and Ronald L. Chatham

Dr. Griffin is an associate professor and Mr. Chatham an instructor in geography at Stanford University. Field work for the present study was carried on in the spring and summer of 1956.

SINCE World War II the California citrus fruit industry has been undergoing a major change. Bulldozers uproot thousands of acres of citrus groves to make way for a population increase of *one every 55 seconds!* Accompanying this fantastic increase are demands for urbanization and industrialization that constitute a revolution in the economy of the State.

Centers of citrus fruit production are rapidly shifting from cities to rural areas. Those who see only the uprooting of citrus groves are inclined to receive strong impressions of the declining aspect of citrus production in California. Actually, some of the industry is being transplanted to more rural sections, e.g., the Central Valley.

Citrus fruit bearing acreage declined 23,420 acres and 20,460, respectively, for Los Angeles and Orange counties—representative areas—in the 1945–1955 period. In the southern counties, responsible for 98 per cent of the State's total citrus fruit production, bearing acreage dropped from 314,910 to 238,190, that is, 76,820 acres.[1] The simple explanation is the necessity for residential development. Not all of the decline in these areas can be described as a locational shift to the Central Valley.

The industry is also experiencing a pronounced decline when viewed within a national framework. For example, in oranges—California's Number 1 citrus fruit—the State had 75 per cent of the nation's total orange-bearing acreage in 1920. By 1950 the percentage had declined to 39, in contrast to Florida's increase from 25 per cent in 1920, to 55 per cent in 1950.

Within a state framework, the citrus industry has declined from a pre-World War II figure of 17 per cent of the State's agricultural production to 6 per cent.[2] By 1955 a 30-year low was reached in Orange County, California's largest producer of citrus crops: 235,000 bearing acres from a 314,910 figure in 1945.

Table I defines the land usages to which the former citrus acreage is being put.

What are the reasons for this change? The answer is, in a word: people. In 1940, California had 6,987,387 residents. In 1950, it had 10,569,000 residents. By March 3, 1957, the State's population passed the 14 million mark!

One of the key population centers is the Los Angeles Basin, where a conspicuously accelerated shift from agriculture to industry is in the making. In the first 50 years of the 20th century when the United States' population was doubling, California's population increased 600 per cent: California moved from twenty-first in population (1900) to second in 1950. Very likely Los Angeles will be the second largest city in the United States within a decade.

[1] The southern counties are Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Tulare, and Ventura.

[2] California Agricultural Experiment Station, Bulletin 731, 1956, p. 3.

TABLE 1

ORANGE COUNTY ORCHARD CENSUS, 1955*: ACREAGE REMOVAL JANUARY 1 TO JUNE 30, INCLUSIVE

	Oranges	*Lemons*	*Grapefruit*	*Others*	*Total*
Subdivision	1,254	21	1	42	1,318
Agriculture	233	30	15	19	297
Industrial	13	8	..	..	21
Freeway	17	..	..	1	18
Flood Control Basin	16	..	..	..	16
Business	13	..	..	..	13
Hospital	11	..	..	..	11
Amusement	2	..	..	..	2
Church	9	..	..	..	9
	1,568	59	16	62	1,705

*Griffin, Paul F. and Robert N. Young, *California, The New Empire State*, San Francisco, 1957.

Drastically increased food demands, marketing changes, and subdivisional necessities have accompanied this influx of people. Similarly, factory developments became most pronounced in the Los Angeles area, which, since World War II, has become the third largest industrial area in the United States, with 11,300 plants. The present rate of expansion is much greater than that of New York or Chicago.

Southern California's rapid urbanization has been reflected in higher land prices and taxations. Land comes into use prematurely if urbanization is not fully called for. One of the competitive problems facing the California citrus fruit industry is the fact that growers paid annually 35 dollars an acre in taxes, in contrast to 9 dollars in Florida. In key counties (Los Angeles and Orange) taxation averaged 45 dollars.

Real estate developments reflect great change. Realtors, alert to new home needs, have offered and still offer fabulous prices to orchard growers for their land. Building contractors have enlarged their activities to an extent unknown before in America. Some 135,000 new homes were built in the Basin in 1955, practically all in the form of subdivisions. Each day new enterprises select choice farm lands to develop them into industrial centers, and every day subdivisions consume the orchards at a staggering rate. Agricultural land is looked upon as residential property, and more subdivisions are always being planned. Some builders employ mass production techniques to construct entire communities designed to house thousands. High land values, soaring taxes resulting from the new need for schools, and public utilities, make it difficult for farmers to persist, even if they wished to do so. They do not so desire, since they pay disproportionately large taxes, especially for schools which serve new subdivisions. Orchardists find themselves too near the new residences to make use of efficient sprays —most of which are highly poisonous— and find that urbanization also adversely affects them in other ways. Rather than struggle against such mounting odds, many of the Southern California

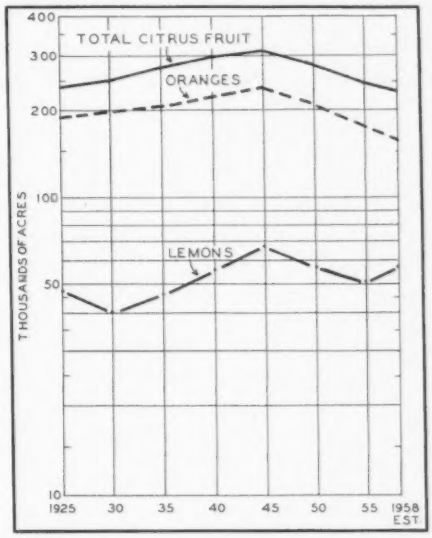
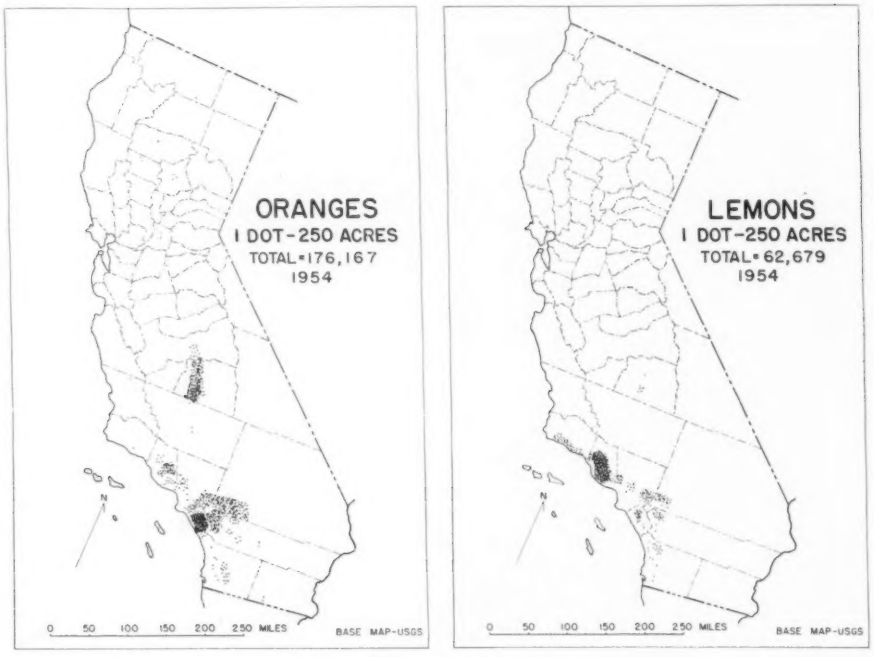


FIG. 1. Trends in citrus fruit acreage in California. (This graph and the three maps appearing later in the article are based on data furnished by agricultural commissioners in each of the California counties producing citrus fruit.)



FIGS. 2 and 3.

orchardists have sold out for unbelievably high prices of anywhere from $7000 to $10,000 per acre and have purchased new and more remote plots at $2000 to $3000 in the Central Valley.

THE CITRUS FRUIT INDUSTRY

These plots in the Central Valley are suitable, if not so ideal as Southern California, for citrus fruit production, which includes oranges, lemons, and grapefruit. First brought to Southern California by Spanish missionaries from Mexico and planted in the gardens of 21 missions, the fruit soon became widespread. The first large planting was made at the San Gabriel Mission near Los Angeles in 1805. Later, American settlers developed the commercial growing of both the orange and the lemon.

The climatic and topographic requirements for citrus fruits are low salt and alkali contents in the irrigation water, and a generally high temperature. The land should slope gently to provide adequate air drainage so that cold air passes easily beyond the trees and settles in the lower parts of the basins. Another requisite is the absence of severe frost and of high velocity winds; likewise, the soils are necessarily well drained and fertile. Land suitable for citrus fruit is at a premium and exists in relatively few sections of California; e.g., the Central Valley and Southern California.

These requisites vary somewhat according to specific fruit. The lemon is a more sensitive citrus fruit than the orange. Still more delicate is the grapefruit. Let us consider these products in terms of citrus fruit crop distribution in Southern California.

THE ORANGE

Conditions are favorable for commercial orange production—particularly

in the Los Angeles Basin. The greatest concentration of groves is in northern Orange County, but considerable acreages exist also below the southern slope of the San Gabriel and San Bernardino Mountains (Fig. 2).

Even within specific areas factors favoring orange growth vary. Localities near the coast in the Los Angeles Basin grow the Valencia type, which yields well under a wide range of conditions. The fruit is juicy, naturally colored, and nearly seedless, coming to harvest from April through November. The inland eastern section of the Basin grows the Washington navel which are winter harvested. Because of its high sugar content and freedom from seeds, the navel is particularly well known as a dessert fruit.

THE LEMON

Lemons are found in commercial quantities in several Southern California counties.[3] The Ventura section is by far the top producer. Two-fifths of the acreage devoted to lemons in this section occurs in the Oxnard Plain; two-fifths is farther inland in the Santa Clara Valley west of Santa Paula—the so-called "Lemon Capital of the World." The remaining fifth is scattered with the largest concentration in the Ojai Valley. Some 8000 acres spread over the sloping fans of land by the ocean and beyond Carpinteria and Goleta (Santa Barbara County) (Fig. 3).

Lemon acreage in Southern California has increased slightly during the decade and lemon production has been rising in value, benefiting from an increase in national consumption of lemon juice products during recent years—products manufactured in Southern California.

[3] San Diego, Riverside, Orange, Los Angeles, San Bernardino, Ventura, Santa Barbara, Tulare, and Fresno.

THE GRAPEFRUIT

Grapefruit is grown commercially in Riverside, San Bernardino, Imperial, Los Angeles, Ventura, Tulare, and San Diego counties. Plantings are widely scattered in most areas in the well-drained sandy loams which are reasonably free from alkali. It is necessary to give special protection against wind, sunburn, and frost—factors which entail a high production cost, disadvantageous to commercial growing. San Bernardino and Riverside counties lead in production; the latter possesses more acreage of grapefruit than all others combined (Fig. 4).

With these requirements in mind, the California grower turns toward a new citrus belt. Where is this significant new area?

THE NEW CITRUS BELT

The southern part of the Central Valley promises to become a mecca of the citrus industry. At present, it is second in importance to that of the south coastal region, and it may very well surpass the latter in orange production as urban subdivision and industry reduce citrus fruit acreages in Southern California (Fig. 2). Many of the Los Angeles and Orange County citrus fruit growers who have sold out their Southern California holdings at considerable profits have bought new plots in the Tulare–Buena Vista area where land values are, at the present writing, considerably lower. Orange groves are clustered along the foothills from Orange Cove south to Rich Grove in Tulare County. Climatic extremes cause the fruit to ripen earlier than it does in the coastal portions of the State, with the result that it can be put on the market before the Southern California crop is ready. Since 1943–44, navel oranges have increased in acreage and now make

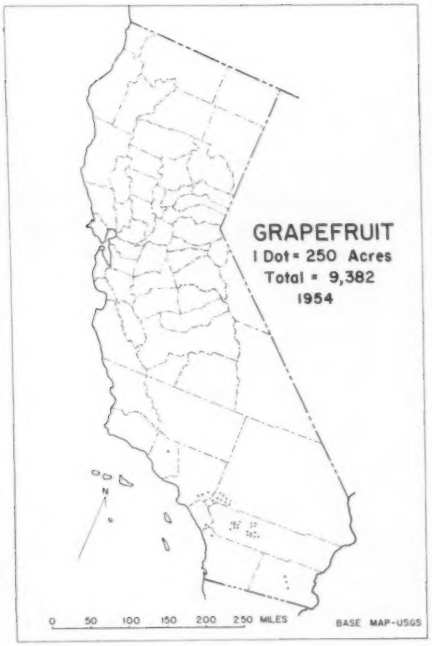


FIG. 4.

up 65–75 per cent of the total crop. Tulare County is the undisputed leader in the production of this variety. At the same time Valencia plantings have declined 25–35 per cent.

The local center of the orange industry and the chief orange shipping point is Porterville. Large plantings are found at Visalia and the region north. The Delano and Edison districts are the principal planting areas in Kern County.

Lemon acreage is found almost exclusively on the higher ground east of Terra Bella. Although the plantings are small, output compares favorably with other lemon districts if ample protection is provided against wind and cold, and has a value of over one million dollars annually. The trees are extremely sensitive to the hot dry summer climate, which means that frequent irrigation is necessary.

Grapefruit is grown on a small scale, and is found mainly in the Edison and Delano regions.

The "New Citrus Belt" does not present complicated export problems. Communications are equally open to the growers in this area. Clearly, diversion of fruit from the domestic market (much less in the new belt) would affect growers' returns. Prices for export fruit often run higher than can be received in the domestic market. The removal, through export, of only a small percentage of the crop has a stabilizing effect on the domestic economy.

Fictional writers sometimes retire seafaring heroes to orange groves on the assumption that anyone can make an easy living growing oranges. Unfortunately, this is not the case. It takes about eight years for a grove to come into fruit. Irrigation water is expensive. Picking and processing procedures may be troublesome, even when handled by such cooperatives as "Sunkist." Oranges are hand-picked, a laborious and expensive process.

CITRUS FRUIT GROVES TO SKYSCRAPERS

California today is the setting of an amazingly rapid transition: citrus fruit grove to skyscraper, especially in and around the metropolitan areas. New homes and factory sites supplant rows of citrus fruit trees. The total citrus fruit acreage has been reduced by a fourth, and production by one-sixth in the last ten years. Less than a quarter million acres remain in production (Fig. 1).

This change, occurring constantly throughout the nation as cities develop, is spectacularly rapid in California. In spite of the urbanization impact upon California's key citrus fruit producing area, the locational shift into a new citrus fruit belt in the Central Valley will sustain this State's major production role for many years in the national agricultural program.

BOOK REVIEWS

West Africa: A Study of the Environment and of Man's Use of It, by R. J. HARRISON CHURCH. xxvii and 547 pp.; maps, ills., index. Longmans, Green and Company, London, 1957. 45/-net. 8¾ x 5½ inches.

Geographers, more especially those with interests in African studies, have long looked forward to Dr. Church's volume on West Africa in Longmans series "Geographies for Advanced Study." It is a massive volume with 89 maps and 121 photographs. The author has drawn extensively on the growing volume of publications in English and French. He has had the advice and guidance of distinguished British, French, Spanish, and Portuguese experts in the area. He has travelled widely in many of the territories he describes, has given orientation courses on West Africa to British Colonial Office cadets, and has worked with French geographers at the Sorbonne. Yet, for this reviewer at least, this study of the "West African environment and of man's use of it" was strangely disappointing.

In part, this reaction was prompted by the apparent lack of balance in the topics handled, by the scanty treatment or omission of some of the most significant aspects of West African geography. Thus 40 pages of Part One ("The Physical Basis of West Africa") are devoted to climate, plus another 12½ pages in Part Three ("The Political Divisions"), in all, about one-tenth of the volume. The section on soils, excluding "soil conservation," receives only four pages; most of this is very general in character and contains, for example, no reference to the soil patchiness which provides some justification for the "wastefully small and scattered patches of African farms" (p. 90) and which is a major obstacle to the development of mechanized agriculture. Disease is mentioned only in passing and in the conclusion, yet it is scarcely possible to understand the economic backwardness of much of Africa or the detailed patterns of population and livestock distribution without reference to the disease factor. Treatment of population is confined to a discussion "from the geographer's viewpoint: namely, distribution and spatial movements, and their correlation with the physical and economic environments" (p. 163). Such terms of reference enable the topic to be dealt with in 10 pages. Racial and cultural contrasts within the area are ignored—it is inhabited by an ideal "geographic man," akin to, and as real as, "economic man." Yet social resistances arising out of cultural contrasts are one of the three major limiting factors to development in Nigeria (p. 514); the dividing line between rice and yam cultivation in West Africa appears to be based on ethnic rather than physical factors (p. 95); "in Senegal the Serer grow (rice) successfully but the Wolof generally do not" (p. 99)—it is, in short, impossible to attain any full understanding of West African geography without reference to the cultural and technological contrasts between the various human groups. There is a very full catalogue of resources, but little discussion of the general background, of the human and social realities behind the figures listed, of the uneven penetration of the Western commercial economy. Yet this commercialization of the traditional economy, with its development of peasant export economies and internal exchange economies contrasting sharply with the subsistence economies of the remoter districts, is one of the major processes making for regional differentiation in Africa today.

In part, the disappointment resulted from the lack of integration in the discussion. One of our prime concerns is surely with "the interrelatedness of all things in a common habitat" and there are few areas where this interrelatedness is clearer than in Africa. Thus, slave raiding, then changes in settlement pattern and increased mobility of the population during the last half century, have contributed to the spread of sleeping sickness; sleeping sickness can be controlled in some areas by stream-side clearing, yet this may lead to erosion; forestry policy demands the reservation of blocks of woodland, but these may be reservoirs of game and tsetse fly. These are relatively simple examples of this interrelatedness; they pose major problems to planners and administrators yet they somehow slip through the mesh of Dr. Church's analysis.

A more controversial criticism derives from the methodological approach adopted by the writer. A basic problem confronting all geographers working on non-Western areas is "To what extent can the (rather stereotyped) procedure of regional analysis developed for European environments be applied in non-Western areas?" The present reviewer's opinion would be, "Scarcely at all." We may take two illustrations from areas of more or less homogeneous physical conditions. Within the Sudan belt of Northern Nigeria there are striking contrasts in vegetation cover, land use, and settlement between the central area focussing

on Kano and the marcher zones between Kano and Sokoto Emirates; within the Middle Belt there are striking contrasts between the Nupe territory in the west and the Tiv country to the east. In both cases these contrasts (this regional differentiation) are explicable in cultural and historical terms. Most of the basic regions are, in fact, human regions, areas within which a particular group, through its agricultural techniques, has made a distinctive imprint on the soil and vegetation of the area, has created also distinctive patterns of cultivation and settlement. Morgan (University College, Ibadan, Research Notes No. 6, 1954, p. 11) has stressed the need for a greater emphasis on human regions, or communities, in geographical work in Africa and has suggested "a method of geographical enquiry by the study of . . . tribal communities in their environmental relationships, instead of by the study of physical regions with incidental reference at a later stage to the people who depend on them." Dr. Church was presented with a unique opportunity to apply such techniques, "a viewpoint derived from African as opposed to European conditions," to the complex West African scene. He has chosen instead to base his account of the political units of the area, on the old-fashioned "scissors-and-paste" technique: historical outline, climate and vegetation, geology and relief, major regions (basically physical), agriculture, livestock, mining, communications. . . . He distinguishes no less than 116 "major regions," but many of these have little relation to geographic reality. The "High Plains of Hausaland" thus include the intensively cultivated Kano area, the almost empty thorn country on the margins of Kano Emirate, the dissected, backward, and pagan Gwari and Kamuku country. . . . Conversely, the Tiv country of the Middle Belt, where the impact of a single human community is creating a clearly marked regional personality, is divided (Fig. 79) between three so-called "geographical regions."

It can, of course, be objected that the sort of emphasis Morgan has suggested calls for the use of material "wholly germane . . . to anthropology and economics" (p. vii) but if, by drawing on such material, the geographer can give a more balanced and satisfying analysis of the regional scene the objection can scarcely be sustained. And there is a certain inconsistency in such an objection since few geographers have qualms about using material equally germane to the physical sciences such as geology or meteorology (e.g., pp. 3–10, 21–22).

This is a useful reference volume, assembling a very considerable amount of factual material, but it fails to capture anything of the quality of West African life or the vividness of the West African scene. These are lost, veiled in a grey harmattan haze of geological details and climatic statistics, of catalogued towns and production data.

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Western Enterprise in Indonesia and Malaya, by G. C. ALLEN and AUDREY G. DONNITHORNE. 321 pp.; bibliogr., index. The Macmillan Company, New York, 1957. $5.75. 8¾ x 5½ inches.

The authors, political economists at the University of London, a few years ago offered their survey of *Western Enterprise in Far Eastern Economic Development: China and Japan*. The present book rounds out their project with a similar description and analysis of two countries in Southeast Asia.

Although this subject has been covered in general terms in numerous treatises, and many specific topics have been examined in detailed case studies, this book is welcome because it brings together and puts in sharp focus the part played by the Western World in the economic development of these former colonial areas. A good deal of valuable information was obtained directly from a large number of individuals and firms engaged in business here. The purpose of the two books is "to investigate the course of Western enterprise in several widely contrasted environments so as to bring to light the diversity in the methods, organization and policies of the Western firms, their varying achievements and the differences in their economic relations with the Asian peoples among whom they operated." In contrast to Japan and China, Western entrepreneurship in Indonesia and Malaya operated within the highly congenial circumstances created by Western colonial rule. Thus economic penetration could go much deeper, especially in agriculture. Also, the colonial governments themselves could take a hand in economic development, as was particularly the case in the Netherlands Indies. Comparisons of this kind, emphasizing differences between Malaya and Indonesia, give perspective to the description. The question is raised whether the contrasts in economic policy between the latter two countries resulted from different doctrines or merely reflected current fashions in political and economic thought. "The answer seems to be that policy was determined by circumstances rather than by doctrine." This statement seems to be going too far. Changing circumstances may have led to change in doctrine, but once the new doctrine became the fashion ("private enterprise"; "free labor"; "ethical policy") it was a powerful tool in shaping the course of events.

After a general introduction in which the chapter on "The Instruments of Western Enter-

prise" is particularly informative, the authors examine in detail Western undertakings in agriculture, mining, banking, shipping, public utilities, commerce and manufacturing. Even readers who know the general substance will find many interesting details concerning the histories of private firms who provided leadership by being alert to the needs for change and renewal. The last chapter gives an evaluation of achievements and a cautious appraisal of the prospects. The appendices contain, in addition to relevant statistics, some interesting notes on special subjects, such as "Trades of the Great East" (of Indonesia). The select bibliography deserves mention because it gives a number of sources in English and Dutch rarely used by geographers.

In Malaya, British enterprise limited itself pretty well to the top-level economic activities. Managing agencies, providing expert local knowledge for the investors, played a large part. In the Indies, larger and more diverse in resources, also with a much longer colonial rule, the structure of economic activities was more complex and private firms with wide ranging interests reached into lower levels of the economy. These and other differences have implications for present and future government policy. The authors also discuss the role of the Chinese, again emphasizing parallels as well as variants between Malaya and Indonesia. From a modest though vital complement to Western enterprise the Chinese have risen to participation in big business, a trend accelerated by the withdrawal of Western entrepreneurs and capital.

In the final chapter the authors come to grips with the critical problem now faced by these underdeveloped countries. "The period in which Western enterprise was in its most vigorous phase . . . was a period of remarkable economic growth. . . ." Ordered government and monetary stability were the foundations on which Western entrepreneurs, endowed with capital, scientific knowledge, and managerial experience, built a multiform economic system. As the West retreats, can adequate substitutes be found to secure further growth? The authors are cautiously optimistic about Malaya—if the perplexing problem of Malay-Chinese relations can be peacefully solved. Regarding Indonesia, where the rejection of European as well as Chinese leadership is the present dominant temper, "the immediate prospects appear to be bleak."

Throughout the analysis the authors have consistently maintained an objective attitude. They are not concerned with proving any economic or political thesis, which is somewhat of a relief amidst the many treatises that seek to fit human actions into a simple formula. The survey, being limited to one specific sector of economic activity, is necessarily one-sided. For instance, the impact of Western enterprise on native society and culture is explicitly ignored. This is no criticism of the book, but a suggestion to the general reader that he should look elsewhere—among authors like J. S. Furnivall, J. H. Boeke, and J. C. Van Leur—to round out the picture of East-West economic relations.

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American Commodity Flow, by EDWARD L. ULLMAN. xxii and 215 pp.; maps, tables, bibliogr., index. University of Washington Press, Seattle, 1957. $4.00. 8¾ x 5½ inches.

This book describes and interprets geographically the railway freight traffic and the waterway freight traffic in United States domestic and foreign trade. There are five chapters.

Chapter I deals with internal commodity flow described in a series of maps showing the locational pattern of United States railway capacity, railway freight traffic flow (based on data from H. H. Copeland and Son), freight flow on rivers and canals, flow of coal on the Great Lakes, flow of coal along the eastern seaboard, and coal shipments from West Virginia by states. The significance of rail and water transport in the nation's total freight circulation is demonstrated by percentages of the nation's total ton-miles of freight movement: railway, 54.6 per cent; waterways (inland, Great Lakes, and coastal), 28.9 per cent; pipe lines, 9.5 per cent; and highway, 7.0 per cent.

Three major characteristics of the flow patterns are given. (1) The first is the cross-grain pattern of rail transportation. Surface configuration of the land is oriented in a general north-south pattern, but the major railway flows cut east-west across the landform patterns. Relationships with "dioric" (through mountains) rivers and gaps are indicated. (2) Both rail and water circulation systems focus on the American industrial belt (which is mapped as "Core Area of U.S. and Canada"). This core area is characterized by the greatest volume of transport in the nation, by an inbound flow of raw materials, and by an outbound movement of finished products. Thus, the in-movement is two or three times heavier than the out-movement of lighter, more valuable, finished items. (3) Coal comprises one-fourth of the rail freight flow and is extremely heavy, moving out from the Appalachian fields northward, westward, and eastward (to the Atlantic, thence by coastal waterway to Baltimore, Philadelphia, New York, Boston, and numerous smaller ports). Some of the longest land hauls of freight in the world are movements to the Industrial Belt of California and Florida fruits and vegetables and Pacific Northwest lumber and forest products.

Chapter II describes the locational pattern

of United States railway company home offices, of home offices by volume of revenue, of traffic solicitation offices, and of principal freight classification yards. Four maps present these patterns. Gateway cities bordering the Industrial Belt are conspicuous on the maps of home offices and classification yards. Chicago, New York, and St. Louis have the largest number of home offices; the largest classification yards are in Enola, Pennsylvania, and Syracuse, New York. Most of the traffic solicitation offices are within the Belt, and the number of such offices correlates rather well with size of cities.

Chapter III analyzes the bases for transportation and interaction, which is the relation between two regions in terms of what moves between them. It is here that the author makes his main contribution of concepts furthering the scholarly analyses of movement between regions. He proposes a system for "explanation of these patterns and physical interaction in general" based on three variables: (1) complementarity, which exists when one region has a demand for and another region has a supply of an item. Complementarity is a function of both natural and cultural areal differentiation. (2) intervening opportunity. "Complementarity, however, generates interchange between two areas only if no intervening complementary source of supply is available." (3) transferability, which is an expression of "distance, measured in real terms of transfer and time costs. If the distance between market and supply were too great and too costly to overcome, interaction would not take place in spite of perfect complementarity and lack of intervening opportunity."

Chapter IV considers state-to-state rail freight movements. Most of the chapter is a series of maps (129 full pages of them) showing each of 20 selected states in terms of states originating and states terminating railway freight shipments by total of all commodities, by products of agriculture, by animals and products, by products of forests, by petroleum products, by products of mines, and by manufactures. Never before has such a thorough job of such mapping of railway freight traffic in this nation been published. Bases for selection of the 20 states is not explained. The most important feature of the pattern of state-to-state rail flows portrayed by these maps is the concentration of flow in the region of state of origin and destination, reflecting the friction of distance and cost of movement (suggesting the importance of transferability). The three states of Iowa, Connecticut, and Washington were selected for analytical discussion because they are similar in number of people but different in terms of economic production (affecting complementarity) and location (affecting transferability). Maps for the remaining 17 states are presented without individual discussion but are intensely interesting objects for analysis by the reader.

Chapter V deals with United States ocean freight traffic. Domestic trade is presented first in terms of five major trading regions (North Atlantic, South Atlantic, Gulf, South Pacific, and North Pacific) and in terms of tonnage of shipments, of tonnage of receipts, major commodities, regions of consignments and regions of origins. Three flow maps vividly show the circulation of total traffic, of tanker traffic, and of dry cargo. By far the major flow is between the Gulf and North Atlantic regions (predominantly tanker movement); the second conspicuous interchange is between South Pacific and North Pacific regions (again primarily tanker). A series of 15 maps portrays by dot symbols the movement of dry cargo, of petroleum and products, and of total flow between each major region and the other four regions. The message of each map is discussed briefly.

Foreign trade is analyzed in terms of dry cargo traffic and tanker traffic, each illustrated effectively by flow patterns on a world map. Major movements of dry cargo are between Atlantic ports and Europe mainly, with South America unquestionably second. The two conspicuous tanker movements are from the Caribbean to our North Atlantic region and from the United States Gulf Coast to Europe.

The bibliography contains 78 references with which every transport geographer should be familiar.

Ullman has made a genuine contribution to the conceptual structure and literature of not only geography but any discipline concerned with regional analysis, especially dynamic relationships between regions. The many maps (covering 158 pages) represent a prodigious amount of work and are effectively constructed, comprising a body of material which should "bring to life" both the study and teaching of transport geography. Textual material, though less in number of pages, helpfully describes the maps and displays illuminating insight of relationships involved.

The author is to be commended for his willingness to present relationships which he does not understand, but believes relevant. He could have omitted them in view of insufficient evidence, but this would have denied the reader many interesting and stimulating ideas from Ullman's imaginative mind.

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The Common Lands of Hampshire, by L. ELLIS TAVENER. vii and 123 pp.; maps, ills., plates, index. Hampshire County Council, Winchester, England, 1957. $8.00. 9¾ x 7¼ inches.

This book, dealing with the common lands of one English county, presents the results of the

first survey of the kind to be undertaken. A parallel survey of Cambridgeshire is also in progress and it is hoped that similar volumes on other counties will follow. Not long ago a Royal Commission, which included Professor L. D. Stamp among its members, was appointed to inquire into the law relating to common lands and to recommend any desirable changes in the law in order to promote the interests of those still holding common rights, to further the use of commons as public open spaces, and to provide for the suitable usage of neglected commons. No improvements can be made, however, until much more is known about the location, distribution, and present condition of the common lands, for no comprehensive record of them exists, still less is it clear as to what rights can now be claimed over them. This in itself presents a complex problem, for by their very nature commons involve a division of interests. Even the total area of such lands is only vaguely known, one recent estimate putting it at 800,000 acres and another at a million acres, but the actual figure may well be considerably greater.

It was in response to the need for such information that Dr. Tavener, already known for his studies of land utilization in Dorset, undertook the survey of Hampshire. The task was substantial, involving a large amount of documentary research, the devising of a technique for recording and analyzing the facts concerning more than 130 commons in the county, as well as the interpretation of abstruse historical and legal data. Yet for a pioneer work of this kind Hampshire provides a rewarding field, for the county is richly endowed with commons of many kinds. They are a legacy of the old *common*, or *open-field* system of agriculture, having for various reasons escaped enclosure. They range in size from a few acres to several hundreds and in character from tracts of heath and rough grazing to small village greens similar to those adjoining the church or courthouse in the early colonial towns of New England.

Although the ancient rights of common, which fall into five categories, are today seldom exercized in full, there are many instances in which villagers hold stubbornly to some of them, especially the rights of pasture. Often, however, the commoners themselves are no longer traceable and even where they are known, few are aware of the rights to which they are entitled. With the rapid growth of towns since the mid-nineteenth century commons have become valued as open spaces and many have been preserved for public enjoyment.

Dr. Tavener's detailed description of the Hampshire commons, with the exception of those adjacent to the New Forest, is arranged on the basis of administrative areas. As befits the work of a geographer, however, a map showing their distribution is included as well as a geological map on the same scale, while a topographical map of the county, in color, is also provided. Not surprisingly, a relationship is revealed between the distribution of the commons and certain of the soil types associated with the geological formations. In a section devoted to this aspect the author shows that the commons most frequently occur on poor soils, i.e., those heavily leached or ill-drained, or those developed on sand and gravel which are generally sterile. Thus the majority are found in the two areas of Tertiary lowland, one in the north forming part of the London Basin and the other in the South forming the Hampshire Basin and also in the extreme east of the county where Lower Cretaceous sediments form the western margin of the Weald. Over the broad central belt of chalk downland, commons are singularly rare though a few occur on patches of the superficial deposit known as clay-with-flints. Reference to the description of individual commons, however, makes it clear that their survival owes much to the events of history.

The book is well printed and contains some useful photographs. Appendices include important historical records and a valuable glossary of legal terms. Apart from a few minor misprints the only obvious blemish concerns the plate showing Selborne Common in which the view does not appear to fit the description given on page 36 and in the title of which the term "hanger," i.e., a beech wood, is misspelled. The index could have been made more serviceable. Though perhaps largely due to the nature of the material dealt with, the arrangement of the text is rather disjointed. In his general discussion of common lands the author has relied too literally on existing accounts by R. Hunter and other authorities. These shortcomings, however, must be measured against the complicated and highly specialized subject, and it is a tribute to the geographer's training that the author has handled it so competently. In a crowded country where every acre should be used to the fullest advantage it is more than ever necessary to possess full knowledge of the existing land. Dr. Tavener has rendered a public service in preparing his survey as have the Hampshire County Council in publishing it.

K. C. EDWARDS

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Soviet Transportation Policy, by HOLLAND HUNTER. xxiii and 416 pp.; maps, tables, diagrs., bibliogr., appendices, index. Harvard University Press, Cambridge, 1957. $8.50. 9¼ x 6¼ inches.

In another of the research studies published under the auspices of the Russian Research Center at Harvard University, Holland Hunter, an economist, has produced an impressive and original analysis of Soviet transport policy

during the period of rapid industrialization under the Five-Year Plans, with particular emphasis on rail transport. Although this study has entailed a prodigious amount of bibliographic research, including a 100-page statistical appendix, the author has never lost sight of the broader implications of these data with respect to Soviet locational and transportation policies. The book is divided into three parts: the locational framework of Soviet transport; the evolution of Soviet transport policy; and the railroads as a sector of the economy. Unfortunately, some of the topics of greatest pertinence to geographers, including the development of the pattern and interregional commodity flow, are barely touched upon.

The initial section sketches the pronounced inequalities in the regional distribution of natural resources and economic activities in the Soviet Union as a framework for the examination of conflicting locational forces. The oft-expressed desire to increase the "evenness" of the distribution of productive forces, which is associated with regional "self-sufficiency" and the reduction in the demand for transportation, has frequently clashed with the stronger desires to accelerate the pace of industrial development and to reap the benefits of plant economies of scale, both of which, according to the author, can best be achieved by concentrating investment in European Russia.

The core of Hunter's study is a long and illuminating analysis of the evolution of Soviet transport policy since 1917. This section is primarily concerned with an evaluation of the persistent Soviet policy of restricting investment in the transportation sector of the economy in order to expand the capital stock of the higher-priority heavy industry sector. Hunter feels that this policy has been successful even though poor timing in the allocation of resources to the railroads in the early 1930's resulted in a "transportation crisis" marked by the accumulation of enormous backlogs of unshipped freight.

Among the more significant implications for economic growth of Soviet experience, Hunter cites the benefits of intensive use of the existing transport plant and the existence of an inverse relationship between the geographic dispersion of economic activity and the speed of industrial development.

Needless to say, in a work of this scope numerous alternative interpretations are possible. For instance, Hunter regards the recent decision to expand coal production in European Russia in order to reduce the volume of coal imports from the Kuznetsk and Karaganda Basins as indicating a retreat from the earlier doctrine of moving industry to sources of fuel and raw materials east of the Volga. This conclusion hardly seems justified since four of the six new iron and steel plants mentioned in the Sixth Five-Year Plan are in Siberia and Kazakhstan and the creation of a Siberian metallurgical base capable of producing 15–20 million tons of pig iron yearly is planned by 1965 or 1970.

Many of the usual criticisms of an economist's work by a geographer apply in this case. Hunter uses only one sketch map. This depicts inaccurately the relatively few rail lines mentioned in the text. Also of concern to a geographer is the author's emphasis on data aggregated on the national scale when a regional scale might be more revealing. For example, Hunter views the close relationship between total coal production and total rail traffic in coal (expressed in ton-kilometers) as demonstrating "the stability imbedded in Soviet industrial geography." However, when coal production and traffic are examined on a different scale the geographic stability becomes more apparent than real. From 1928 to 1955 the share of the eastern regions (including the Urals) in total coal production increased from 20 per cent to 46 per cent. Much of the apparent stability since 1945 seems to be based on more intensive utilization of short-haul, low-grade coal and lignite, which has offset the enormous increases in the long-haul flow of Kuznetsk and Karaganda coal. A similar type of approach is reflected in Hunter's assertion that inputs invested in the outlying areas of the Soviet Union because of inherently unfavorable conditions for economic activity will yield a smaller return than corresponding investment in European Russia. Although this position possesses some validity in a gross sense, it has serious drawbacks as a guide to an accurate appraisal of the efficiency of investment in Soviet Asia. Such an appraisal should consider the particular location and specific type of economy being developed. For instance, if a given quantum of inputs were channeled into the expansion of fuel-oriented industry it seems unlikely that returns would be lower in Soviet Asia than in European Russia, even taking secondary investment into consideration.

In discussing Soviet rail technology Hunter mentions that plans for the expansion of the rail plant by 1960 indicate a modest decline from previous goals. The data he uses, however, include only a few general criteria and quite a different conclusion might have been reached were such important programs as the all-out drive to electrify main lines or the laying of heavy rails considered.

When the magnitude of Hunter's contribution is considered any criticism seems minor. He has successfully merged painstaking research with broad, yet penetrating, analysis to produce a highly competent study of Soviet transport policy. This work should be of great interest to economic geographers specializing in the Soviet Union and also to geographers investigating the role of transportation in areas embarking upon a program of rapid industrialization.

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